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FRIDAY, JULY 6, 1888.

IN THE DIFFERENT THEORIES which have been suggested to explain the constancy in the radiation from the sun, at least during considerable time-intervals, it has been generally supposed that the temperature of the sun has not varied essentially, and in order to explain this constant temperature it has been necessary to find some source for an accession to the sun's heat. For this purpose we have the chemical theory of burning, the meteorite theory of heat being produced by the falling into the sun of vast masses of meteors, and the theory of contraction. In all these theories it is assumed that the temperature of the sun must remain constant if the amount of warmth radiated from it is to remain the same, and that, if the temperature of the sun were to sink, the amount of energy radiated must decrease. Mr. John Aitken, in a recent number of the Proceedings of the Royal Society of Edinburgh, calls attention to the fact that these premises are not absolutely necessary, since the amount of radiated energy may increase even when the temperature decreases. The facts upon which he bases this possibility are the following: 1. It is known that the power of radiation varies with the form of the material, for instance, the flame of the Bunsen burner, although of a higher temperature, radiates less warmth than that of the ordinary gas-flame; 2. As a rule, the elements radiate less warmth than compounds, and observation has established that the amount of radiation increases with the complexity of the molecular structure; 3. It is well established that at high temperatures dissociation takes place, and compounds become less complex. We see, therefore, that in the sun, on account of its high temperature, substances must exist in less complex form than on the earth, to which conclusion many of the recent deductions of Lockyer specially point. It is therefore probable that the radiating power of the material of the sun is far less than that of the earth; also that the hotter the sun, the simpler its constitution, and just so much smaller its radiating power. It is, then, no longer necessary to assume that the temperature and the amount of radiated warmth from the sun are proportional. The temperature can decrease, and at the same time, on account of the change in the chemical constitution of the sun, the amount of radiation may increase. Sir William Thomson has recently calculated the numerical data, according to the Helmholtz theory of the sun's warmth, and has found that the sun would have to contract thirty-five metres yearly in order to produce the energy which it radiates according to Pouillet's measurements. In this connection it should be said that Langley's measurements give a far larger warmth-radiation from the sun, and that they are probably too small; so that the sun would have to contract much more than thirty-five metres a year in order to produce its radiating energy through the force of gravity. But evidently energy would be produced in the sun in other ways during the cooling-off. The falling temperature, for instance, would allow of compounds being produced, which act of burning, as it were, would add to the temperature. Mr. Aitken acknowledges that his suggestions are of the nature of speculations, but he has published them in order to bring out the possibilities that the radiating power of the sun may have changed, qualitatively and quantitatively, from time to time, that its amount does not necessarily vary directly with the temperature, and that it is very doubtful whether we may apply to the material of the sun the observations on radiation which we have obtained in the laboratory.

AMONG THE 'MOVEMENTS' agitating the country is one known as the 'Old South Work.' This is not, as might be supposed, a move to stop the growth of the 'New South,' of which we hear so much, but an attempt, and a vigorous one, which started with some public-spirited ladies of Boston, with Mrs. Mary Hemenway at the head, to interest and instruct the population now living within the borders of the United States in the history of the country, especially in so far as it has an influence on present conditions. Too much time has been spent in the schools in laying before the pupils the, at this epoch, unimportant details of the early Indian wars, with the result of leaving them uninformed of later events, the effects of which have a much more immediate influence on their lives. Many believe that the American mind is empty of American history, and fear that this may lead to ignorance of those principles which have given us the success which is now our portion. But why call this movement to educate Americans in what their fathers and their grandfathers did the 'Old South Work'? It is simply that because of this ignorance, which bred indifference, the people of Boston were willing a few years ago that the Old South Church, one of the theatres for some of the most stirring acts of the Revolution, should be wiped from the face of the earth. To save the building as a reminder of the revolutionary deeds of Boston, Mrs. Hemenway gave liberally of her time and money. This was one act in striving to interest Americans in America and her history; and for some years Mrs. Hemenway was nearly alone in sustaining the 'Old South Work.' Now we are glad to chronicle that the movement has grown, and has gone West. At Chicago Mr. Edwin D. Mead has instituted a series of lectures. In Madison, Wis., a similar course has proved so popular that hundreds have been turned away each evening for lack of room. Again, in Indianapolis this instruction of Americans in what Americans have done has been found to meet such approval as to lead to similar courses in the larger towns of Indiana. We hope, that, like most 'movements' which go from the East to the West, this may prove to have the necessary staying qualities, and that the rising generation may know how the political problems they have to solve have grown from what went before.

THE GOVERNMENT EXHIBIT AT CINCINNATI.

THE National Museum, the Smithsonian Institution, the United States Geological Survey, and the Bureau of Ethnology will make a joint exhibition at the Cincinnati Centennial. Although the time for preparation has been very short, the law making the necessary appropriation not having been approved until May 28, the government scientific exhibits will be in Cincinnati in good season, and will constitute one of the most interesting features of the exposition.

In determining what to show, those in charge have been greatly embarrassed by the abundance of material from which to choose. Cases of selected objects will be taken from several departments of the National Museum, but mainly from the departments of anthropology, zoölogy, and of arts and industries. Those selected from the department of anthropology will illustrate the plan upon

which the National Museum is being arranged, by means of a number of cases showing the geographical distribution and physical characteristics of the races of men, the processes and results of some of the most primitive arts, and also by a collection illustrating the subject of biblical archæology, and a collection of remains of prehistoric man in Europe, Asia, and America. The Bureau of Ethnology will also make a display in connection with this department, choosing for its topic the pueblo of Zuñi, its arts and industries, and also an exhibition of models of Indian mounds of the Mississippi valley.

In the department of arts and industries two subjects will be illustrated. The first will be the history of trade and commerce of the United States, in connection with which will be shown a series of models exhibiting the history of water-transportation in the Ohio valley, and another series showing the history of land-transportation for three centuries, especially in connection with the migration across the Alleghany Mountains. There will also be a series of models showing the different rigs of sea-going vessels.

The other subject to be illustrated in this department is the history of the graphic arts in America. This collection is in preparation under the direction of Mr. S. R. Koehler, who has recently set up in the National Museum a collection of a similar nature. The exhibit to be sent to Cincinnati will be an extension of this series. It will consist, first, of a series of selected specimens showing each method of engraving ever practised, one group illustrating wood-engraving, another etching, another copperplate, another mezzotint, and so on. There will also be shown, as fully as possible in the space assigned, a collection illustrating the history and present condition of the art of engraving and etching in America and by American artists. There will also be shown in considerable detail the history of engraving by mechanical processes, beginning with photo-lithography, and extending through all the modern processes of photo-engraving, autotype, photogravure, etc.

The foundation of this part of the exhibit will be the magnificent historical collection presented to the Smithsonian Institution by J. W. Osborne of Washington. Other series taken from the museum collections also form the nuclei of exhibits that have been greatly extended by loans from representative American engravers and etchers.

Another collection will show the history and applications of photography in America. This was begun four years ago by Mr. Smillie, the photographer of the National Museum, and will be exhibited for the first time in Cincinnati. A collection of engraved portraits of men connected with the history of American science, which has been accumulating in the Smithsonian Institution for twenty years, will also be sent to Cincinnati. Photographs of objects in the museum too valuable or too large to be removed, a complete set of photographs of the Grant and Washington relics, and a set of photographs showing each exhibition hall and laboratory in the National Museum and Smithsonian Institution, complete the list of exhibits by these two bureaus. Many objects sent to Cincinnati in 1884, and which are therefore familiar to those who will visit the exhibition this year, have been omitted from the present contributions.

The United States Fish Commission has been assigned three thousand feet of space in the exhibition-building. The centre forty-five feet of this space will be devoted to aquaria, representing a sloping, rocky hillside with plants and trees and a rustic fence. Over the rocks will fall a cascade into a pool below, six feet nine and one-half inches long, and three feet seven inches wide. From this pool the water will be conducted by a miniature McDonald fishway into a basin twelve feet long and six feet wide. The pools will be filled with fish, and water-plants will grow about the edges. The aquaria, thirty-eight in number, will be constructed in two rows in the rocks in the rear of the waterfall. They will contain specimens of all the *Salmonidæ* available, the brook-trout, the rainbow-trout, the Loch Leven trout, the lake-trout, and land-locked salmon, besides specimens of the principal species of food-fishes of the Ohio valley and Lake region, and carp and goldfish. These aquaria will be in charge of Mr. W. P. Seal, and the entire Fishery Commission exhibit will be managed by Capt. J. W. Collins.

In the remaining space will be shown the apparatus used in scientific investigation by the officers of the Fish Commission, — an outfit for deep-sea dredging and exploration, etc.; a collection of implements and pictures illustrating fish culture and distribution; a series of casts and other representative specimens of fishes, mollusks, and marine invertebrates that are sought for food, to illustrate the objects of the fisheries.

In a separate department the story of the fisheries will be told, mainly by an extensive collection of large photographs and crayon drawings illustrating the methods employed in the fisheries, the boats and apparatus used, and even the manner and condition of life of those engaged in the fisheries. Among other interesting objects to be shown will be four large maps illustrating the distribution of the principal food-fishes, and fish used for bait in the Atlantic from Cape Hatteras to Labrador; a statistical map showing the yield of the fisheries of the country; a map showing in a graphic manner the work done in shad-propagation on the Atlantic coast, and one showing the increase in the catch of shad from 1880 to 1888.

MANNERS AND MEALS.

IN a paper by Garrick Mallery, on manners and meals, published in the July *American Anthropologist*, the author makes no attempt to exhume ancient customs from the ruins of the past, nor to describe those found in the low strata of culture represented by savage and barbaric peoples, which also explain details of our own prehistoric past. The line of thought deals rather with the customs of our own daily life in civilization. Its object is to notice those which show instructive peculiarities, and to ascertain their cause or occasion and their origin, in which attempt antiquarian research and ethnic parallel must be invoked for aid, though approached in a manner rather the converse of the usual anthropologic discussions.

It is perhaps not too much to say that a dinner-party thoroughly good in *ménu*, cookery, service, æsthetic appliances of sheen and color, culinary chemistry, the conquest over nature shown in condiments from every clime, roses in winter, and in summer ice, and last, though by no means least, in the guests with educated palates, affords altogether the strongest every-day evidence of high civilization. Brutes feed. The best barbarian only eats. Only the cultured man can dine. Dinner is no longer a meal, but an institution. An eminent jurist pronounced that the whole result and aim of the institutions and laws of England was to get twelve men in a box. It would hardly be a parody to contend that the most obvious result of our modern æsthetic and industrial triumphs is to get twelve legs under a table. Few will now assert that asceticism is intellectual. It is now truly regarded as a reversion to the plane of savages; and this is made more clear by the fact, that, when asceticism as regards food prevailed, it was accompanied with filth, and even want of decency in clothing.

A large part of the important work of the civilized world is accomplished or regulated at social dinners. Theodore Hook was reproached for bringing so many dinner details into his novels, and he defended himself with the assertion that the dinner was the great theatre of London life. Our fellow-citizens, some decades ago, were foolish enough to procure the recall of Reverdy Johnson as minister to the Court of St. James on the ground that he was spending all his time at dinners, but it was at them that he was successfully prosecuting his work. In Washington, not only diplomatic but many legislative and official transactions are arranged at dinners. This is in contrast with savage and barbaric life. Feasts were then the means of bringing people together; but the deliberations were before or after, and even ordinary conversation was unknown at the feeds. This perhaps is more strictly true among peoples who did not use alcoholic intoxicants as beverages; for the ancient Persians had a rule to vote in council twice, once sober and once drunk, so as to observe the mooted question from two points of view.

Anciently (and still in the lower stages of culture) no regular hours for meals were observed. Savages eat when they can get food, and continue to eat so long as the food lasts. The history of civilization may be traced in the changing hours of refection. Confining the examination to Europe since the middle ages, the maxim in the reign of Francis I. of France was "to rise at 5, dine at 9,

sup at 5, and couch at 9." Under Henry IV. the court dined at 11, and noon was the rule in the early years of Louis XIV., though in the provinces distant from Paris the dinner-hour remained at 9. In the household ordinances of Henry VIII. of England, the dinner was established at 10, and the supper at 4. This arrangement seems to have been then old, as Froissart mentions waiting on the Duke of Lancaster at 5 in the afternoon, "after he had supped." The differentiated meal, breakfast, with a special character of food, such as we now know it, is of very recent date. A posset or some other confection to stay the stomach was taken on rising without approach to a table, and even now Parisians habitually have their *café au lait* with a trifle of solid food in their bed-chambers, and wait several hours after rising before partaking of what they call, as distinct from *goûter*, the *déjeuner*, a meal often answering in composition to the old dinner of mid-day. A substantive change even with them is the hour of the latter meal, which is late in the evening, or in the night, instead of early in the afternoon, as it was a few generations ago.

The position of the participants at any formal repast has been attended by intricate punctilios, as much probably among savages as in the most ceremonial courts of Europe. Whether the host should be on the right or left of the door of the wigwam or tepee is a traditional ordinance, and the order in which the calumet should be passed is strictly regulated. The most modern and most judicious arrangement of the guests at a dinner-party disregards their social or official importance, and seats them with reference to their personal peculiarities, tastes, and mutual adaptation. Nevertheless, there still remains a relic of former ceremonials in the apparent necessity for the host and hostess to take into dinner and place at their respective right hands the most distinguished two of opposite sex among their guests. But, apart from this distinction, the diagram of seats is arranged to promote agreeable conversation; which object, as before remarked, is entirely ignored in savage and barbarian repasts.

The question as to who is to be served first is one about which much has been written by professors of etiquette. It seems now to be decided that on occasions where the entertainment is given for the special honor of a particular guest, or where any one of the guests towers above the others in point of dignity, such guest should be first served; but until quite recently it was obligatory for the host or hostess, or both, if both were present, not only to be first served, but actually to eat before any of their guests. This custom originated in the attempt to guard against poisoning, which was common, though apprehended more frequently than was warranted, during the middle ages. It is not traced to primitive man. On the contrary, the general rule seems to have been that the giver of a feast did not eat or drink at all, but waited upon the guests, and that practice is found still existing in many parts of the world.

The posture of the several nations or peoples when at meals has been discussed, without much result save to mark its connection with the invention of furniture and utensils. Savages who squatted or sprawled at other times, squatted or sprawled then. So luxurious nations, or their wealthy members, who habitually reclined on couches, did so at feasts.

A modern company being assembled and seated, the preliminary of grace or form for an address to the Deity or superior powers demands attention. Reference to antiquity and to the practices of uncivilized tribes shows that this almost universal form by no means originated with Christianity. It was a sacrifice to and placation of the gods. Sometimes the whole of the viands were formally offered to them; and nearly always a portion, symbolical of the whole, was actually disposed of by burning or burying in or pouring upon the earth. The early Christian Church, adopting this Pagan ceremonial with many others, gave it in time a new and far more elevated sentiment. Instead of the formula of fear, it became that of gratitude to the giver of nourishment and continued life. It is instructive to inquire into the reason why the ceremony of pronouncing grace either before or after meals has of late years so decidedly fallen into disuse. This change undoubtedly preceded the present agnostic disregard of religious services in general, and seems not to have been connected with it, but to have been induced by special influences. Religious writers have conscientiously argued that the time when a man was hungry and in sight of the food which occupied his attention was not appropriate to prayer. Others claimed that the end of the meal, when the mind was made sluggish by feeding, was also inappropriate. The perficient objection was probably the inconvenience to the service of the repast. At all events, few subjects were more prolific of jests, squibs, and derisive anecdotes during the last century than that of asking grace. Perhaps this ridicule has had effect upon its disuse.

The duty of the entertainer among us is to subordinate his own dinner to attention to the perfect service of his guests. Among the northern Algonkins and Iroquois, he had another function. He must not eat, and no one talked, but his special duty was to sing. In some Chinese circles the entertainer goes out of the banquet-room, and leaves his guests to unobserved revelry. Davy Crockett would have approved of this, as he declared that the politest man he ever saw was the Philadelphian who handed him the decanter of whiskey and then looked out of the window.

It is laid down in some books of etiquette that upon the conclusion of each course, in order that the servant may be aware that the time has arrived for a change, the guest shall lay his knife and fork parallel to each other upon his plate, but it is also observed that it is extremely vulgar to place these instruments crosswise upon the plate. There is a tradition in reference to the crosswise arrangement, that it accompanied a religious formula of blessing the pabulum which had then been consumed and was relegated to the digestive apparatus. In this connection it may be noted, that, before the fork was common, the Guelphs or imperials placed their knives and spoons longwise, and the Ghibellines or papal faction placed theirs crosswise, on the table. This practice of subsequent blessing has gone into desuetude with even more generality than has that of invoking preliminary grace. Becoming rejected, persons who used the sign connected with it showed themselves behind the times; *videlicet*, low-bred or vulgar.

In all repasts of uncivilized peoples it is remarkable that certain kinds or parts of food were refused by particular individuals, or avoided by the whole body of feeders.

At this time and in this country, but two relics of these superstitions would probably be met. One might occur on any day in case a strict Israelite were present; and another, relating to the days of the week and seasons of the year, would be apparent in the abstinence of other religionists.

The explanation once offered, that the Mosaic prohibition of certain animals, especially the hog, as food, was founded in profound hygienic wisdom, is not now considered satisfactory. Pork in good condition is recognized to be as healthful food as other meats in the same condition throughout the world, and it is now eaten with the same immunity in Syria as in Ohio. The modern Israelites offer most interesting notes to the ethnologist by their continued preservation, in the midst of a high civilization, of the religious taboo of savagery. This rite has had paramount influence beyond that of their written doctrines, in their segregation from the nations in which they have sojourned; and, now that it is becoming less strictly observed, there are evidences of their ceasing to be a peculiar people.

The refusal, at certain times and seasons, of food that in itself is hygienically good and palatable, in placation of a deity, or, without further explanation, to avoid bad luck, is well known among the lower tribes of men. Fasting may be either *jejunium*, in which all kinds of food and drink are prohibited, or *abstinentia* in relation to specified articles.

The origin of fasting is probably to be found in physiological considerations. There is a marked loss of appetite in the reflex result of grief, fear, and other strong emotions, from which noticed fact abstinence may become the conventional symbol and sometimes pretence of those emotions, and afterwards a formal act of homage to their inspiring cause. Certain it is that the practice has been found in all times and in every race of man, and therefore has no necessary connection with Christianity.

A similar explanation, *pro tanto*, attends the substitution of fish for other meats; but this topic has some peculiar features. In the early riparian populations the arrival from the mysterious depths of waters of the shoals of fish, on which they depended, was, and still is among savages, always signalized by religious ceremonies. In the same connection may be noted the rites of our plains Indians

in imploring and celebrating the coming of the less mysterious herds of buffalo. The wonderous fecundity of the fish early made it the symbol of life and the creative power. The Israelites often relapsed into the worship of the fish-gods of Phœnicia. In the early Christian Church the fish symbol for Christ, adoption of which was probably influenced by the traditional sentiment indicated, anteceded the acrostic of his name and titles in Greek, Ἰησοῦς Χριστός Θεοῦ Υἱός Σωτήρ, presented by the letters of the Greek word ΙΧΘΥΣ, though the permanence of the symbol was doubtless enchanced by the literary coincidence.

The old doctrine of 'signatures,' so called, had its effect in the adoption of fish as spiritual food. It was cold, and the meat was generally white, thus coinciding with the symbolism of temperature and color to express purity.

It is fortunate that some rules in relation to repletion are no longer observed. One which was noticed among the Hurons and the Canadian Algonkins by the early French missionaries, and styled *le festin à manger tout*, consisted in the religious obligation, sometimes attended with loss of life, of the communicants to eat up every particle which was set before them. A festival, somewhat of the same nature, was called the 'glutton mass,' celebrated in England during if not after the reign of Henry IV. A less dangerous, because regulated, term of repletion was prevalent in India, according to a Brahman tradition, in which the invitees, before commencing the carouse, bound themselves around the abdomen with a band of straw; and their modified feat was, not to eat indefinitely until all had been devoured, but only until the straw bands should burst. There is no survival of this custom except in the exaggerated hospitality, generally rustic, in whch the host persists in petitions that the guests should continue to eat, without reference to their apparent wishes. Modern etiquette shows marked improvement in never suggesting either selection or quantity of provender.

The conclusion of our dinner raises again the vexed question concerning the retirement of the lady *convives* to leave the men alone. Of course, it is well understood that the object among the hard-drinking Englishmen of the last generation was to permit their sitting for the excessive consumption of wine without the disturbing restraint of the sex. The French, being less addicted to intoxication, and perhaps more professedly attached to the presence of the fair, did not admit this usage. It, however, is a partial survival of the ancient practice, still observed in most savage tribes, in which the women never eat in company with the men. A relic of this is found in the order of Bishop Grosseteste in 1450: "Streytly forbede ye that no wyfe [that is, woman] be at your mete." In this country, and indeed now in civilized Europe, there is less addiction to heavy drinking, with a greater desire for smoking after repletion: so a convenient compromise has been effected by which the gentlemen adjourn to a smoking-room, while the ladies segregate themselves for gossip.

It is well to have an agreement as to who is to take the lead in departure, by which the party is broken up. A difficulty of this kind occurred when Dom Pedro, Emperor of Brazil, was a few years ago invited to an entertainment at the White House in Washington. At a late hour, when some of the guests, becoming weary, were about to take their leave of the President's wife, she remonstrated, saying correctly that it was the etiquette for the crowned head to depart first, and all others must await his pleasure. Now, the Emperor had asked the question about our etiquette in this regard of an honest Senator, who was confused about the 'receiving party' being always composed of the persons of greatest dignity, and pronounced that Pedro must stay until all not of the household had departed. It was not till about 3 o'clock in the morning that the dead-lock was broken by the illness, real or pretended, of one of the worn-out ladies.

ANOTHER disease has been classed among the germ diseases. Dr. Arthur Nicolaier of Göttingen states it as his belief that tetanus, whether in man or beast, is the result of a micro-organism of the rod form, whose spores are widely scattered over the earth. This microbe favors the production of poisons in the system into which it is introduced, which act similarly to strychnine.

SCIENTIFIC NEWS IN WASHINGTON.

How the Washington Scientific Societies were founded; the Old Scientific Club; the Philosophical, Anthropological, Biological, Chemical, and Geographic Societies; the Cosmos Club; the Proposed Publication of Quarterlies. — Micmac Pictographs; Colonel Mallery's Investigations Last Year. — The New Naval Observatory Building to be erected at once.

The Washington Scientific Societies.

A FEW years ago the Scientific Club was the only organization of that character in Washington. It met fortnightly at the houses of its members, listened to the reading of papers, and closed with a collation. It had many very interesting meetings, at which important papers were read; but the zeal of its members was not as great as its organizers had hoped for. The reason for this seemed to be, that, nearly all the scientific men in Washington being specialists, they were greatly interested only in those lines of inquiry in which they were themselves engaged, and in such others as were directly or remotely related to them. But the papers at any given meeting of the Scientific Club might interest only a very few of those who were present. There was no way to fit the subjects to the audience, or *vice versa*, where both were so diversified. It was therefore thought best to have specialized societies instead of one general one, and a beginning was made by the organization of the Philosophical Society. It met fortnightly, as the Scientific Club had done, but in a hall instead of at a private residence, and the collation was omitted. The meetings were well attended, the entire time was occupied with valuable and interesting papers, and the zeal of the members grew instead of diminishing. The Philosophical Society in due time carried the idea of specialization a step farther, and organized a mathematical section, at whose meetings papers upon pure and the more abstruse mathematics and its applications were presented instead of in the meetings of the full society. There is no lack of material for the fortnightly meetings of this section, or of interest on the part of its members.

The next of the Washington scientific societies to be organized was the Anthropological. The almost exhaustless amount of valuable archæological remains that were being discovered and collected for preservation, the successful work of the Bureau of Ethnology, and the labor of classifying, arranging, and discussing the collections, caused the employment of a great number of scientific men in different branches of Anthropology, and they formed a society for the discussion of these topics. It has been as successful as its less specialized predecessor, the Philosophical Society. There is never any lack of interest, or any difficulty in securing sufficient papers to fill up in their reading the full two hours that the society is in session on every alternate Wednesday evening during the season.

For like reasons, and attended with an equal measure of success, the Biological Society, the Chemical Society, and the Geographic Society have been organized. The last-named, although the youngest, already has more than two hundred members, and all of its meetings during the past season have been successful ones. Mr. Gardiner G. Hubbard is the president of it.

When the Philosophical Society was formed, the social element, which had been one of the attractive features of the old Washington Scientific Club, disappeared. The meetings being held in a hall instead of in private residences, and the entire time of the meetings being occupied with the reading of papers, the members found that they had very little opportunity to become acquainted with each other; and so, in order that the social advantages might not be lost, the Cosmos Club was formed. It began in a modest way, taking rooms in an upper story of the Corcoran Building, and furnishing them comfortably and tastefully, but not expensively. There were reading, writing, smoking, billiard, and card rooms; the first supplied with the leading daily and weekly papers of this country, and with the principal magazines and periodical scientific publications of the United States and Europe. The initiation fees and annual dues were moderate, and the Cosmos Club flourished from the beginning. It is now established in its own house in one of the most central and beautiful locations in Washington, and is the resort of the scientific men in Washington. Once a month, during the winter, a loan exhibition of paintings, objects illustrating

some branch of science, fine scientific instruments, curios or bric-a-brac, is prepared in the club-house. Some of those of the past season have been exceedingly interesting and instructive. The privileges of the club are extended to all scientific and literary men from a distance who visit Washington; and one meets there during the season, besides the members, scores of people one likes to know.

Two or three years ago the Cosmos Club extended its house by adding a fine assembly-hall, and in this the several scientific societies hold their meetings without expense for rent, etc. Although this hall communicates directly with the club apartments, and, when not occupied by one of the societies, is used as a reading-room, it has an independent entrance from the street.

The Washington scientific societies have, until the past season, published nothing but their proceedings, including the briefest abstracts of the papers presented; but last fall the Anthropological Society began the issue of a quarterly, in which have appeared some of the most important papers read before the society, printed in full. The Biological and Chemical Societies have concluded to begin similar publications next season, and the others will probably follow their examples at an early date. The entire scientific community in Washington has been interested in the abstracts of the more important papers read in the meetings of these societies, that have appeared in *Science* during the past few months.

The three older societies established two years ago the free courses of popular scientific lectures that are given in the auditorium of the National Museum on Saturday afternoons during the winter and spring. They have been successful and thronged from the beginning, and were noticed editorially in *Science* recently.

The coming decade is to be the seed-time of science in Washington. The material for study comes pouring into the scientific bureaus like a flood, more rapidly than it can be handled. Congress is disposed to be liberal in granting money for this work, having confidence that it is wisely and economically done. In certain branches there is far better and more abundant material for study than elsewhere in the country, — as good, indeed, as there is in the world, — and the Washington scientific societies promise to do their full share in giving to the world some knowledge of our scientific treasures and what they teach.

Micmac Pictographs.

In introducing the narrative of his investigations in Nova Scotia, and afterwards in Maine, last year, Col. Garrick Mallery, of the Bureau of Ethnology, says that he does so with the more satisfaction because he is alone in that field. No one before him has examined or discussed the pictographs of the Micmacs or Abaki, or indeed published any allusion to them, except in some incidental and unappreciative manner.

"The Micmacs," he says, "were an important tribe, occupying all of Nova Scotia, Cape Breton Island, Prince Edward's Island, the northern part of New Brunswick and the adjacent part of the Province of Quebec, and ranging over a great part of Newfoundland. . . . In 1611 the Micmacs were estimated at 3,000 to 3,500. In 1760 they were reported at nearly 3,000, but had lately been much wasted by sickness. In 1766 they were again placed at 3,500; in 1880 they were officially reported at 3,892; and in 1884 they numbered 4,037. Of these, 2,197 were in Nova Scotia, 933 in New Brunswick, 615 in Quebec, and 292 on Prince Edward's Island."

After quoting from the writings of missionaries and others references to the picture-writings of the Micmacs, and giving accounts of several attempts to reduce these to a system, and even to print books in them, Colonel Mallery continues: "So far, my examination of the Micmac hieroglyphs shows that the best mode of interpreting the aboriginal characters involved in them is by the sign-language. This does not now prevail as a matter of general use among the Micmacs; but stories and traces of it survive, and the gestures of other members of the Algonkin family can be applied. Quite a number of the Micmacs remember the use of marks or devices on birch-bark in their common details of life, such as notices of departure, and warning of danger.

"My search for petroglyphs, or rock-carvings, in the land of the Micmacs, or, as the railroad-guides now call it in honor of Longfellow, the land of Evangeline, was unsuccessful, except in one notable instance. Nevertheless I am confident, from ascertained traditions, that there are more to be found. Much of the territory is yet unexplored, and the inhabitants are wholly neglectful of such subjects. The nearest neighbor, a middle-aged farmer who has lived all his life at the same spot, about three miles from the unique and probably most important pictured rocks to be described, had but a vague knowledge of them, and had some trouble in piloting me through them. These rocks are on the margin of a lake which is almost on the boundary-line between Annapolis and Queen's Counties.

"The proper literation of the name of the lake called 'Cegemacaga' in More's 'History of Queen's County, N.S.,' according to Dr. Silas Rand's work, 'First Reading-Book in Micmac Language, comprising Indian Names of Places,' is 'Kejimkoojik,' translated as 'swelled parts,' doubtless referring to the expansion of the Liverpool River, which forms the lake.

"The Fairy Rocks, as distinct from others, are three in number, on the east side of Kejemkoojik Lake, on the south of the entrance of Fairy Lake, the northernmost of the three rocks being immediately at the entrance. The westernmost and central one of the rocks, saving a small surface, at high water, and at the highest water, are entirely submerged.

"Three other rocks are about two miles south of the above, at Piel's Point (a corruption of 'Pierre's Point'), opposite an island called Glode's or Gload Island, probably named from a well-known Micmac family. These are virtually a continuation of the same formation, with a depression between them. All of these rocks are of schistose slate, Silurian formation, and with so gentle a dip that their magnitude varies greatly in accordance with the height of the water. On Aug. 27, 1887, when, according to the reports of the residents, water was at one foot above the average summer level, the unsubmerged portion of the central rock then surrounded by water was an irregular oval, the dimensions of which were forty-seven by sixty feet. The highest points of the Fairy Rocks at that date were not more than three, and few were more than two, feet above the surface of the water. The inclination near the surface is so small that a falling of the water of one foot would probably double the size of that extent of the surface which by its smoothness and softness was fit to be marked upon by scratching. The inclination at Pierre's Point is steeper, but still allows a great variation of exposed surface in the manner mentioned.

"Mr. George Creed of South Rawdon, who, I believe, is the only intelligent man in the peninsula who ever visited Fairy Rocks before me, did so in July, 1881, and accompanied me last year. His attention was entirely directed to the northernmost one, which was then much more exposed above the water than in September, 1887, and much of the inscribed portion seen by him in 1881 was under water in 1887. That the parts of the rocks adjoining those exposed are inscribed, is evident, as the inscriptions were seen in 1881 by Mr. Creed through the water, and again through a water-glass in 1887. His recollection of the inscribed dates seen in 1881 is that a number were of the last century, and some with French names attached were earlier than 1700, the worn appearance of which justified the correctness of the date. A number of markings were noticed by him which are not found in the parts now exposed, notably among which were fishes and whales. There were also wigwams and native animals, evidently of more ancient marking than the etchings of horses, ships, houses, and other European objects which are more frequent on the constantly exposed surface. A noticeable point was that the large surface where the rock was smooth was completely marked over, no space of three inches square being unmarked; and over nearly all the surface there were two, and in many cases three, sets of markings, above one another, recognizable by their differing distinctness. It also seemed that the second or third marking was placed upon localities where the earlier markings have been nearly smoothed out or obliterated: therefore the antiquity of the earliest must be considerable. With pains and skill the earliest markings can be traced, and these are outlines from which intrinsic evidence is obtained that they were Indian; whereas the later and more sharply marked outlines are obviously made by civilized men or boys, the latest being mere initials or full names of persons, with dates attached.

"I saw dates on the part exposed from 1800 to the current year, the number of last year being much the greatest over the favorable surfaces for marking; and, when these were found, the double or treble use in some instances was noticed.

"After having actually gotten on to the rocks, and discovered what they were and how to distinguish and copy them, it appeared, that with the exception of a very few characters recently dug or chipped out by lumbermen or visitors, almost always initials, the only interesting or ancient portions were scratchings, which could be made by any sharp instrument on soft and polished slate. The rocks were great drawing-slates, affording a temptation to any idly disposed person to scratch. Happening to have with me an Indian stone arrow which had been picked up in the neighborhood, I used that upon the surface, and it would make as good scratches as any upon the rocks, except the very latest, which were evidently cut with metal knives by the whites. The time in which I was actually at work in taking copies was very short, only parts of two days; and then a violent storm arose, which continued for several days, during which time it was impossible not only to see the faint scratchings which were of interest, but even to move over the rocks, as they were rendered as slippery as glass by the moisture; and then I was forced to leave for Washington.

"The mode in which I took the copies was by running over and through their outlines with a blue aniline pencil, and then pressing a wetted sheet of linen or paper upon them, so that the impression was taken as by print. Purposely, in order to experiment upon a successful mode of getting the copies, I made my first work upon those that were of least apparent interest, *experimentum in corpore vili*, so that I should not by my operations spoil those which were of more importance. The main object which I had in the examination of the inscriptions was to ascertain whether there were upon these rocks any of the more simple and more probably aboriginal characters that are found in the hieroglyphs of Kauder. In the short time that I was at work I discovered certainly two of the characters what were in Kauder's work. Both of these are similar to, but not identical with, symbols of the Roman Catholic Church.

"It still remains undetermined whether those particular characters were imitated by Indians during the last two hundred years from religious symbols collected by Kauder, or whether those religious symbols had been adapted from some characters which had previously been in use. A more extensive examination and study of the characters on the rocks, of which probably there are thousands that I did not copy, or indeed carefully examine, would be necessary before it could be determined to verify my hypothesis that the scratching of symbols on these rocks would be explanatory of the Micmac printed hieroglyphs.

"On one point the peculiar multiplication of the characters affords an index to antiquity beyond what is generally possible. The existence of two or three different sets of markings, all visible, and of different degrees of distinctness, is in itself important; but, in addition to that, it is frequently the case that the second and third in the order of time have associated with them dates, from which the relative antiquity of the faintest and dateless can be to some extent estimated. The third and most recent class of dates are English names, and are associated with the forms of English letters; the second class are French names, and in some cases have French designs.

"There is an interesting story on this subject which was communicated to me from Louis Labrador, whose great-grandfather, old Ledore, according to his account, piloted a body of French Acadians, who, at the time of the expulsion in 1756, were not shipped off with the majority. They escaped the English, and travelled from the valley of Annapolis to Shelbourne, at the extreme south-east of the peninsula, and were on their way from May to October. During that passage they halted for a considerable time to recruit in this beautiful valley along the Kejimkoojik Lake, the very spot where these markings appear, and which was on the ancient Indian trail. It is exceedingly probable that the French would have been attracted to scratch on these fascinating smooth slate surfaces whether or not they had observed previous markings, but it seems evident that they did scratch over such previous markings. Therefore the latter antedated the middle of the eighteenth century.

"One of the printed impressions taken in the manner before mentioned is of a bat between an armed brig and troops or Indians on land, which might have been one of the several naval expeditions against the Acadians; as, for instance, that of Argall in 1614, or Cromwell's of 1654, and which was etched as of historical interest by the French wanderers at the time mentioned. The rig of the vessel has not been used for at least a century, and the 'top' where men are shooting at those on shore reminds of the old sea-fights under the Stuarts. The artist has drawn his brig down to the keel without reference to the displacement of water or to perspective, and afterwards superposed the shore-line and its defenders.

"The other impressions, copied on linen, and presented to show the character of the work on the rocks, but by no means its intrinsic value, are a peculiarly drawn star appearing many times in Kauder's book, though five-pointed instead of seven, — a dragonfly with some fainter characters. A grotesque group — probably a French caricature — is two eels, and two birds perhaps intended for herons.

"Other impressions taken by me on paper, and mounted on cardboard, show a small star of the same character as before given, but five-pointed, some faint designs resembling those of Kauder but not identical, an animal supposed to be a bear, an aboriginal head and bust, a very artistic moose, and a cluster of three trees differentiated at their roots, and conjectured, by comparison with a Passamaquoddy inscription, to signify the first, second, and third chiefs of the tribe.

"In connection with the scratchings on the soft and polished surface of the rock, which seems to invite them, the thought occurs that the art of picturing, and subsequently of writing, is in all parts of the world determined by the ready and convenient material; as, for instance, the papyrus of the Egyptian, and parchments in other parts of the ancient world; the hides of deer or buffalo among the hunting tribes of this country. But the most tempting and convenient of all material appears to have been the birch-bark, which is found generally through the whole of the northern Algonkin region. This can be used in two entirely distinct modes, — one in which outlines are drawn by any hard-pointed substance on the inner side of the bark when it is soft, and which remains indelibly when dry; the other made by scraping on the rougher outer surface, thus producing a difference in color."

The New Naval Observatory.

The contract for the erection of the new Naval Observatory buildings, on Georgetown Heights, near Washington, has been awarded by the secretary of the navy for $307,811. This contract does not cover the piers or the domes, which are to be built by experts under the direct supervision of the observatory officers. There are to be nine buildings in all, including the main building; the great equatorial building, where the great telescope will be mounted; the clock-room, where the observatory clock will be set up and the naval chronometers kept and corrected; two buildings for observers' rooms; the east and west transit buildings; and a boiler-house. The material used will be Tuckahoe marble. Work is to be begun immediately, and the buildings are to be completed within eighteen months.

ELECTRICAL SCIENCE.

Electric Launches.

MR. RECKENZAUN, of the Electric Accumulator Company, has fitted up a small launch, to be run by an electro-motor supplied with electricity from secondary batteries. The launch has no features of especial novelty, excepting the fact that it is the first boat propelled by stored electricity that has been used in this country. A full charge of the battery will take her about eighty miles; and she can be more easily controlled than an ordinary launch, besides being noiseless, and free from heat and dirt. In speed, weight, and the distance she can go, she compares favorably with steam-launches of the same size, while in point of comfort she would far surpass them. There is a field for these boats at present on men-of-war for general use, or for torpedo-boats, for which last purpose their noiselessness makes them especially valuable. They could

be used, too, on larger yachts, and for pleasure-boats by those who can afford them, and where there are facilities for reaching the battery. An important use just at present is to call attention to the possibilities of storage-batteries, and to encourage inventors to improve the present uneconomical and weighty types.

The launch in question is twenty-eight feet long, has six feet beam and a depth of three feet. The batteries are under a couple of benches running fore and aft. The motors are under the deck aft. The motors are governed by a handle near the steering-wheel. With seven-horse power the boat is said to make twelve miles, with two-horse power about six miles, an hour.

COST OF ELECTRIC TRACTION. — The following table is the result of calculations made by experts on the cost of horses, cables, and electric storage-cars on the Fourth Avenue street-car line, New York: —

	Electric.	Horse.	Cable.
Cost of cars	1	.54	.81
Motive power	1	1.45	1.06
Construction of roadway	1	.53	2.09
Depreciation and repairs	1	1.47	2.04
Operating expenses (including wages)	1	3.38	1.71
Total	5	7.37	7.71
Average	1	1.47	1.55

For this road, then, storage-cars would, provided the estimate be correct, be much cheaper than any other system. Fortunately, these figures will have a practical test, since the Julien Company is equipping ten storage-cars for the line. So much for storage-cars. Where overhead wires are permissible, there seems no doubt of the advantages of electric traction. The Union Passenger Railway in Richmond, with the Sprague system, is carrying over 250,000 passengers a month, at a cost of less than $1\frac{1}{2}$ cents a car-mile; the total operating expenses, every thing included, being only 47 per cent of the receipts. What electric railway systems using a conduit between the tracks for their conductor can do, remains to be seen. For haulage in mines, the reports are most encouraging. Mr. Shaefer, at a meeting of the Engineers' Club of Philadelphia, stated that the cost per ton-mile in the anthracite-coal mines was as follows: mules, 1.82 cents; steam, .6 cent; electric motors, .4 to .67 cent. Considering the very obvious advantages of electricity as compared with steam in mining-work, the figures are strongly in favor of electricity for traction in mines. Outside of cost, electricity presents the advantages of cleanliness and perfect control; and the above figures, taken in two cases from actual and continued experience, show, that, when properly applied, it is superior in economy as well.

LIGHTNING-FLASHES. — W. Kohlrausch has estimated the current and quantity of electricity in a lightning-flash. He calculates that it will take 9,200 ampères to melt a copper rod of 2.5 centimetres diameter. Such a current concentrated in a flash would contain from 52 to 270 coulombs, which would decompose from 5 to 25 milligrams of water, and form 9 to 45 cubic centimetres of explosive gas. If this energy were stored up and distributed for electric-lighting, it would require from 7 to 35 flashes to keep one incandescent lamp lighted for an hour.

AN ELECTRO-CHEMICAL RADIOPHONE. — The *London Electrician* gives an abstract of a communication to the Académie des Sciences by MM. Chaperon and Mercadier, describing a galvanic cell made by them which is sensitive to the action of light. "It consists of a plate of bright silver covered by the electrolysis of sulphate of sodium with a thin layer of sulphide of silver, immersed in some electrolyte other than an alkaline sulphide, water containing a trace of sulphuric acid being as good as any thing. The electro-motive force is feeble and variable, and the cell polarizes rapidly, but its current undergoes an instantaneous change when exposed to daylight or even to weak artificial light. The authors investigated the rapidity of action by exposing the cell to the beam of the oxyhydrogen light, made intermittent by passing through a revolving wheel pierced with holes. A telephone was included in the battery circuit, and sounds were produced so high in the scale as to correspond to more than 1,000 vibrations a second, which showed that the electro-chemical effect must be produced in less than $\frac{1}{2000}$ of a second. No corresponding change was produced in the resistance of the cell: so the effect of the light must be to cause a variation in the electro-motive force.

EXPERIMENTS ON THE ELECTRIC ARC. — The fall of potential in the electric arc has been generally held to be due to two causes, — a resistance increasing with the length of the arc, and a counter electro-motive force independent of the length. This may be expressed by the formula $E = a + bl$, where a and b are constants, and l is the length of the arc. Dr. Lecher, in a paper in the *Centralblatt für Electrotechnik*, describes experiments which tend to disprove this view. He first found that the resistance of the arc does not increase very rapidly when it is extinguished: this he showed by putting the primary of an induction-coil in the arc-lamp circuit, first pulling the carbons apart, and second extinguishing the lamp. There was a spark in the secondary in the first case, but not in the second: so the resistance, on extinction, could not have increased with very great rapidity. This being the case, Dr. Lecher placed in the lamp-circuit a galvanometer, the needle held against a stop for the direct current, but free to swing in the opposite direction. He then suddenly cut out the feeding-current, and there was no swing of the galvanometer-needle in the opposite direction: so, if there was a counter electro-motive force in the arc, it must have disappeared at the same time the feeding-current ceased. To see if the difference of potential of the arc depends on the temperature of the carbons, they were heated by a blowpipe. With a normal difference of 42 volts, this rose to 48 volts when the positive, and 52 volts when the negative, carbon was heated. When the carbons are horizontal, the potential difference is less than when they are vertical, on account of the higher temperature in the latter case. When the carbons are cooled, the potential difference is less. For example, representing the difference by $a + bl$,

	a	bl	
Carbons horizontal, uncooled	33	$4.5l$	±1.5 volts
" vertical, "	35.5	$5.7l$	±1.5 "
" horizontal, cooled	25	$5.0l$	±3.0 "

To find in what part of the arc the fall of potential really occurred, a carbon rod of small diameter was introduced into the arc, and the difference of potential between it and the carbon electrodes was taken. It was found that the difference of potential between the +carbon and *any* part of the arc was about 36 volts. This being the case, it is assumed that the rest of the fall of potential is at the −carbon. Dr. Lecher also experimented on the nature of the current forming the arc, but the method used is questionable. He claims that his investigations show: 1. The existence of a back electro-motive force is doubtful; 2. The difference of potential is affected by temperature; 3. If the negative electrode is platinum or iron, the discharge is discontinuous.

THE RADIO-MICROPHONE. — Mr. C. Vernon Boys has described before the Royal Society an instrument for measuring very small changes of temperature. "It is an extremely delicate form of thermopile, consisting of a square frame made of one turn of one square centimetre, of which three sides are thin copper wire, and the fourth is a compound bar of antimony and bismuth, each piece being $5 \times 5 \times \frac{1}{8}$ mm., soldered edge to edge. This frame is supported by a thin rod to which is fastened a mirror, and the whole is hung by a tortion fibre in the field of a powerful magnet. When radient energy falls on the centre of the compound bar, the frame is deflected, and the amount of deflection measures the energy. Adopting suitable dimensions, and using a very strong field, an instrument may be made capable of showing a change of temperature of the junction of one thousand-millionth of a degree."

BOOK-REVIEWS.

Forms of Animal Life, a Manual of Comparative Anatomy. By GEORGE ROLLESTON. 2d ed., revised by W. Hatchett Jackson. Oxford, Clarendon Pr. 8°. (New York, Macmillan, $9.)

THOSE who in years past have been familiar with Rolleston's 'Forms of Animal Life' will welcome the very much enlarged and modernized edition that makes its appearance after a lapse of seventeen years. Opinions may and will differ as to how the principles of comparative anatomy are best taught, but no one will deny

that he will be well taught who follows this bulky manual faithfully through. The work has been thoroughly revised, largely rewritten, and very much increased in size, by Professor Rolleston's collaborator and successor, Mr. W. H. Jackson. For the benefit of those who are not familiar with the former edition (and there are comparatively few students in recent years in America who are familiar with it), a few words relative to the scope of the volume may be given. The first part of the volume is essentially a laboratory guide, illustrated by plates, of the anatomy of various selected types of animal structure; the second and larger part contains systematic morphological descriptions of the classes and higher divisions of the animal kingdom, with briefer discussions of the different orders, both fossil and recent. The descriptions are very comprehensive, essentially comparative, and modern. Not the least valuable part of the work are the bibliographies appended, in both parts, to type or class, and so arranged as to open up to the student special lines of study in any direction he may select.

The work is alike valuable to the special student and teacher of comparative anatomy, and will be scarcely less useful to the paleontologist and college teacher of zoölogy, as well as forming an excellent adjunct and continuation to Huxley and Martin. To the undergraduate, or even non-specialist post-graduate, almost its only service will be that of a work of reference. As Professor Rolleston says, the distinctive character of the book "consists in its attempting to so combine the concrete facts of zoötomy with the outlines of systematic classification as to enable the student to put them for himself into the natural relations of foundation and superstructure." But no student can appreciate or grasp the broad morphological principles underlying classification until he has first familiarized himself with the details upon which those principles are based. In Huxley and Martin's 'Biology' the other extreme is taken, and facts, only, presented; in the present work we believe that a much more thorough acquaintance with the actual structure of animal bodies is needed than is presented in the first part, before the student can avail himself of the more systematic morphological portion. The work is not complete in itself: it needs and will be supplemented by others; nevertheless it is one that no zoötomist or zoölogist can afford to be without.

A Course of Elementary Instruction in Practical Biology. By T. H. HUXLEY. Revised and edited by G. B. Howes and D. H. Scott. London and New York, Macmillan. 16°. $2.60.

HUXLEY and Martin's 'Practical Biology' has long since won an enviable place as a text-book in our best institutions, and the present edition contains many important improvements that will meet the approbation of teachers. In size, the present is nearly twice that of the former edition, and its arrangement has been materially changed. Especially do we approve of the principle, that has already been accepted by other authors in similar treatises, of starting the student in on work that is more familiar to him, and gradually leading him to less familiar fields, rather than the adherence to a more logical and systematic but less practical view of living structure. In the present edition the arrangement has been so changed that the student is first taken through a careful study of the frog, and then follows successively the study of the cray-fish, earth-worm, snail, mussel, polyps, animalcules, yeast, protococcus *Spirogyra*, bacteria, moulds, stoneworts, fern, and bean. Even with the present arrangement, we believe that the student's interest would be sharpened, and his skill increased, by a preliminary study of the best-known and most familiar of all structures, the human body. The portion devoted to the frog has been most largely increased; and the additions of the earth-worm, snail, and *Spirogyra* add to the value of the book. The appendix is a happy addition to the work, and is a good, fresh, and succinct account of microscopic material and technique.

The work is undoubtedly accurate: the authors' names are not needed as a guaranty of this. The omission of figures and plates is objectionable to some; but the true use of the work, that of a guide to the student in the examination of specimens for himself, neither requires nor desires such. It is too advanced for the general undergraduate student, but is excellent for post-graduate work in preparation for medical studies. Some day, though we fear it may be far in the future, such preliminary work as this will be required of all medical students: it would go far towards mitigating the very just opprobrium under which most medical colleges of our country now suffer, — that of being the most unscientific of all scientific schools. The work would be improved by a more comparative morphological treatment. But little is said of the general principles underlying structure, and the relations of the general types are not made apparent, as they should be.

A Popular Zoölogy. By J. DORMAN STEELE and J. W. P. JENKS. New York and Chicago, Barnes. 12°. $1.40.

First Lessons in Zoölogy. By A. S. PACKARD. 2d ed. New York, Holt. 12°. $1.

BOTH of the above text-books are by well-known authors, coming simultaneously from Brown University, and both are worthy of commendation; but both are not of like merit in all respects, nor adapted for the same class of pupils. Steele and Jenks's book is designed to interest and instruct; Packard's, to instruct and interest. The former is more elementary and popular; the latter, for a somewhat older grade of pupils, and is more scientific. The one deals with the familiar forms of life more fully, — there is an undue amount on birds, — and is rather too much after the style of Tenney; Packard's work is more philosophical, and treats of principles rather than of details.

If is very difficult in a text-book on zoölogy, especially one intended for young pupils, to hit the happy mean between meaningless details and a dry, uninteresting compendium of comparative anatomy. Furthermore, the value of an elementary zoölogy depends upon who the teacher is. If he is, as is too often the case, one who knows as much about the principles of zoölogy as he does of those of the Aztec language, then no book will be of much value; if he is a good zoölogist himself, he does not rely very exclusively upon any text-book. For the pupil who must depend largely upon himself, Steele and Jenks's book, with its numerous good illustrations and anecdotal style, can be recommended; but, for the more scientific yet interesting application of the principles of animal life and its classification by a qualified teacher, the excellency of Packard's work cannot be gainsaid. The additions in the present edition of the last work are confined to the *Insecta*, *Ctenophores*, and the horseshoe crab.

NOTES AND NEWS.

IN 1887 an association was formed in Ireland for the promotion of silk-culture in the south of the island. The hope was to utilize land now devoted to very unproductive crops. The Journal of the Society of Arts states that the river-valleys of Munster are especially suited for the growth of the mulberry-tree. The present effort to introduce silk-cultivation divides itself into two parts, — first the cultivation of the mulberry-tree, and next the rearing of cocoons. To accomplish these objects of the association it is proposed, and is actually being done on a small scale, to distribute mulberry-trees among those who last year reared such silk as to "equal any Italian or other silk." Count Dandalo, in his Italian work on the silkworm, says that Ireland, from many circumstances, appears peculiarly favorable to the cultivation of silk. The experiment of rearing silkworms is being tried by about thirty families, but large results are not expected at once, as the imported mulberry-trees will not leaf well in the first year. It is remarked, that, if the re-afforesting of Ireland be desirable, some of the trees should be the useful mulberry. Another part of the scheme is to introduce reeling-machines, which can be used by ladies in their own homes. Sericulture has been in every country rather an occupation for the family than for the factory, which gives it a special claim to attention, at a time when those whose circumstances forbid them from seeking employment outside their own homes are suffering keenly from the general depression.

— The Society of Science of Harlem has just published Volume I. of the works of the illustrious Huygens. This is a volume which will be of special value to the physicists and historians, and we can but commend this republication of the works of the pioneers in science. The Physical Society of France has done a similar piece of service in republishing the works of Coulomb and Ampère.

— M. Wolf announced at the meeting in the French Academy, June 11, that Captain Dfforges had discovered in the archives of the Ecole des Ponts et Chaussées a number of notes by Prony which show him to have been the discoverer of the modern methods of determining the force of gravity. In 1792 Prony proposed to substitute for the simple pendulum a rod oscillating successively on three parallel knife-edges. Later, in 1800, the study of his first apparatus led him to a contrivance which was nothing less than the reversion-pendulum proposed in 1811 by Bohnenberger, and applied for the first time by Captain Kater in 1817. Unfortunately the many professional occupations of Prony and his journeys did not permit him to make such a pendulum, and the memoir of 1800 was never published.

— An exhibition of hygiene opens at the Palace of Industry in Paris on the 20th of July. Another exhibition for the same purpose, also containing a section devoted to the fine arts and the industrial arts, opened at Ostend on the 30th of June.

— A recent number of the San Francisco *Bulletin* contains some facts as to the exhibition under the auspices of the California State Board of Silk Culture. "The exhibition is of a highly practical nature, and comprises, in addition to reels, filatures, and cocoons, over fifty thousand worms in different phases of development, a great number of which, however, have reached the spinning-stage, and are industriously engaged in the evolving of their costly product. The manager of the work, Mrs. Louise Rienzi, is an enthusiast in regard to sericulture, and is to be largely credited for the rapid progress made by the board during the two years it has been established. The impetus given to sericulture in California by the labors of the board has pushed the industry forward vastly. Large invoices of cocoons are daily received, besides considerable quantities of raw silk sent to be spun on the improved filature machinery imported from Italy for this purpose. Appropriately enough, the majority of those who have engaged in silk-culture in the State are ladies. Communications are received every day from those desirous of obtaining information necessary to the establishing of silk-farms. Besides being furnished with a book of instruction, all who apply may obtain eggs or worms in embryo, as well as mulberry leaves, trees, and cuttings. Fully sixteen thousand trees and cuttings were distributed last spring as food-supplies for the worms on silk-farms located at Dutch Flat, Paso Robles, Brentwood, Antioch, Howell Mountain, Sebastopol, Visalia, Santa Paula, Templeton, Chico, Rutherford, San José, Irvington, Danville, Anderson, Los Angeles, Eureka, San Bernardino, Fresno, Livermore, Bowlder Creek, and numerous other towns throughout the State. The leaves of one three-year-old tree are estimated to be sufficient for the nourishment of an entire colony of silkworms, while one hundred trees will supply the wants of as many worms as can be attended to in any but the largest establishments. The supply of trees and cuttings at the command of the board was exhausted early in the present season, but the many applications held over will be filled from the stock of fifty thousand trees which will be procured for next season.

— The *American Meteorological Journal*, desiring to direct the attention of students to tornadoes, in hopes that valuable results may be obtained, offers the following prizes: for the best original essay on tornadoes, or description of a tornado, two hundred dollars will be given; for the second best, fifty dollars; and among those worthy of special mention fifty dollars will be divided. The essays must be sent to either of the editors, Professor Harrington, Astronomical Observatory, Ann Arbor, Mich., or A. Lawrence Rotch, Blue Hill Meteorological Observatory, Readville, Mass., U.S.A., before the first day of July, 1889. They must be signed by a *nom de plume*, and be accompanied by a sealed envelope addressed with same *nom de plume*, and enclosing the real name and address of the author. Three independent and capable judges will be selected to award the prizes; and the papers receiving them will be the property of the journal offering the prizes. A circular giving fuller details can be obtained by application to Professor Harrington.

— At the meeting of the Engineers' Club of Philadelphia on June 16 it was voted that the club join in the invitation, which had been extended by other societies, to the International Congress of Geologists, to hold its fifth session, in 1891, in the city of Philadelphia.

— In his article in a recent number of *The Forum*, Professor Thurston takes occasion to remark that the world is awaiting the appearance of three inventors greater than any who have gone before, and to whom it will accord honors and emoluments far exceeding all ever yet received by any of their predecessors. The first is he who will show us how, by the combustion of fuel, directly to produce the electric current; the second is the man who will teach us to reproduce the beautiful light of the glow-worm and the firefly, a light without heat, the production of which means the utilization of energy without a waste still more serious than the thermo-dynamic waste; while the third is the inventor who is to give us the first practically successful air-ship.

— The Manhattan Chapter, New York, of the Agassiz Association, held a silk exhibition at 103 Lexington Avenue, commencing Friday evening, June 29, at 8 P.M., with a lecture on silk by C. F. Groth, and continuing Saturday, June 30, from 3 to 10 P.M.; Sunday, July 1, from 3 to 10 P.M.; and Monday, July 2, from 3 to 10 P.M.

— Prof. H. P. Bowditch has made an important contribution to the growing literature of the 'knee-jerk' phenomenon, the importance of which as an index of nervous condition is now so widely recognized. Using an apparatus that allows the force of the blow and the extent of the excursion to be recorded, he asks the subject to firmly clinch the hand (and thus re-enforce the knee-jerk) upon a given signal. After an interval varying from .1 of a second to 1.7 seconds, the blow is struck, and it is found that the effect of the re-enforcement varies with the interval. It is greatest immediately after the hand is clinched, and with an interval of .4 of a second has disappeared. With an interval of .4 of a second to 1 second, there is a diminution of the knee-jerk, followed by an increase, reaching the normal again at 1.7 seconds. There is thus a short period of exaltation, followed by a depression and a slow return to the normal.

— A paragraph is going the rounds of the press, with what truth we know not, to the effect that a company was recently started in Philadelphia for the purpose of investigating the pyramids of Egypt by boring into them with diamond drills, thereby penetrating into some of the mysteries which have so successfully baffled the investigators of centuries.

— The observations of M. Perrotin at Nice, and M. Terby at Louvain, and, in England, of Mr. Denning at Bristol, have confirmed, according to *Nature*, the presence on the planet Mars of most of the 'canals' or narrow dark lines which were discovered by M. Schiaparelli in 1877, and at subsequent oppositions. M. Perrotin has also been able to detect, in several cases, the gemination or doubling of the canals, and M. Terby has observed the same phenomenon in one or two cases, but with much greater difficulty than in the opposition of 1881–82. But some curious changes of appearance have been noted. An entire district (Schiaparelli's *Lybia*) has been merged in the adjoining 'sea;' i.e., its color has changed from the reddish hue of the Martial 'continents' to the sombre tint of the 'seas.' The district in question is larger than France. To the north of this district a new canal has become visible, and again another new canal has appeared to traverse the white north polar cap, or, according to M. Terby, to divide the true polar cap from a white spot of similar appearance a little to the south of it. With the exception of these changes, the principal markings, both light and dark, are those which former oppositions have rendered familiar.

— We learn from *Nature* that admirable arrangements have been made for the London meeting of the International Geological Congress, from Sept. 17 to 22 next. The meetings will be held in the rooms of the University of London, Burlington Gardens, where accommodation for the council, committees, exhibition, etc., has been granted by the senate of the university. There is a refreshment-room in the building, and there are several restaurants and hotels in the immediate neighborhood. Arrangements will be made at one of these restaurants for a room to be set apart for the social meetings of members of the congress. The opening meet-

ing of the congress will take place on Monday evening, Sept. 17, at 8 P.M., when the council will be appointed, and the general order of business for the session will be determined. The ordinary meetings of the congress will be held on the mornings of Tuesday, the 18th, and succeeding days, beginning at 10 A.M. In the afternoons there will be visits to museums, or to places of interest in the neighborhood of London. Arrangements for the evenings will be made at a later date. The ordinary business of the congress will include the discussion of questions not considered at Berlin, or adjourned thence for fuller discussion at the London meeting. Among these are the geological map of Europe, the classification of the Cambrian and Silurian rocks and of the Tertiary strata, and some points of nomenclature, etc., referred to the congress by the International Commission. Miscellaneous business will also be considered. In addition to these questions, the organizing committee proposes to devote a special sitting to a discussion on the crystalline schists. An exhibition will be held during the week of the congress, to which geologists are invited to send maps, recent memoirs, rocks, fossils, etc. Foreign members of the congress are invited by the council of the British Association to attend the meeting of that association at Bath. During the week when the association meets, there will be short excursions in the neighborhood of Bath, and longer excursions will be made after the meeting. At these excursions excellent sections of the lower secondary and upper paleozoic rocks will be visited. Excursions will take place in the week after the meeting of the congress (Sept. 24 to 30). The number of these will depend upon the number of members desirous of attending, and upon the districts which they most wish to visit. The excursions at present suggested are: (1) The Isle of Wight (visiting the Ordnance Survey Office at Southampton on the way), cretaceous, eocene, oligocene. (2) North Wales, Pre-Cambrian and the older paleozoic rocks; West Yorkshire (Ingleborough, etc.), Silurian and carboniferous limestone. (3) East Yorkshire (Scarborough, Whitby, etc.), Jurassic and cretaceous. Should the number of members be so large as to make additional excursions necessary, they will probably be: (4) Norfolk and Suffolk, pliocene (crag) and glacial beds. (5) To the Jurassic rocks of central England. The short excursions during the week of the congress will probably be to Windsor and Eton, to St. Albans, to Watford, to Brighton, to the Royal Gardens at Kew, and to other places of interest. Brief descriptions of the districts to be visited in these excursions will be prepared (with illustrative sections, etc.), and will, if possible, be sent to members before the meeting. The full report of the London meeting will be issued soon after the close of the session. It will contain, in addition to reports of the ordinary business of the congress, the report of the American committee on nomenclature (about 230 pages); the memoirs on the crystalline schists (about 150 pages), and reports of discussion on the same; and probably a reprint, with additions, of the report of the English committee on nomenclature (about 150 pages).

— An international horticultural exhibition, we learn from *Nature*, is to be held at Cologne from Aug. 4 to Sept. 19.

— On the 4th of June, according to *Nature*, Dr. Maxwell T. Masters was elected a corresponding member of the Institute of France, in the Botanical Section, in place of the late Prof. Asa Gray. Besides Dr. Masters, the following names appeared on the list of presentation: M. Treub of Batavia, Mr. Triana of Paris, M. Warming of Lund, M. Wiesener of Vienna. Dr. Masters obtained 39 votes; M. Triana, 5; M. Treub, 1.

— We are glad to learn (from *Nature*) that a pension of £50 has been granted to Mrs. Balfour Stewart from the civil list.

— Messrs. Thomas Whittaker & Sons, New York, have published an admirable 'Planisphere showing the Principal Stars visible for Every Hour in the Year.' It is substantially made, and convenient for use in our latitude. —— *Outing* for July opens with 'An Irish Outing Awheel,' from the pen of 'Faed' Wilson. The illustrations of Irish scenery by Harry Fenn are handsomely reproduced. The number contains plenty of summer matter. Samuel M. Baylis is the author of 'After Trout in Canadian Waters.' Other articles are 'Richfield Springs,' by Mrs. M. B. Hedges; 'The Angling Tournament,' by Francis Endicott; etc. —— The July volumes of Ticknor's Paper Series will be as follows: 'Two College Girls,' by Helen Dawes Brown, ready July 7; and 'The Rise of Silas Lapham,' by William D. Howells, ready July 21. —— Macmillan & Co. are about to publish in two volumes a second series of Carlyle's letters, extending from 1826 to 1835, edited by Professor Norton. —— The J. B. Lippincott Company have in press 'Stanley to the Rescue: the Relief of Emin Pacha,' by A. Wauters, president of the Royal Geographical Society of Belgium. It will contain a map and thirty-four illustrations. —— G. P. Putnam's Sons publish this week 'The Story of Turkey,' by Stanley Lane-Poole, which forms the nineteenth volume of the story of the Nations Series.

— Mr. Joseph Jastrow has been elected professor of experimental and comparative psychology at the University of Wisconsin. This is very gratifying, as it shows an interest in this country in the scientific aspect of mind.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

The Rainfall at Fort Leavenworth, Kan.

IN 1837 rainfall observations were instituted at Fort Leavenworth under the supervision of the post surgeon, and the record was continued, with but few breaks, until October, 1883. In the latter year, in view of the proximity of the Signal Service station in Leavenworth City, the authorities at the War Department, or the officers at the fort, suffered this magnificent record to be discontinued. The length of the series, surpassing any other record west of the Mississippi, and antedating by almost twenty years the settlement of Kansas by the white man, has made it of especial value as evidence upon the question of a secular change in rainfall over the Western plains.

The observations up to 1874 were rendered generally available by their publication in the 'Smithsonian Precipitation Tables' and in the 'Report of the Kansas Board of Agriculture for 1874;' for the years 1871 to 1880 they were published in 'Professional Paper No. IX.' of the Signal Service; and for 1881 to 1883 they have not been printed, or at least have not become generally accessible. The series subsequent to 1873 seems, moreover, to have been little used, and discussions of secular change in rainfall have generally been made by completing the Fort Leavenworth series since 1873 with the Signal Service records at Leavenworth City, the entire comparability of the two series being assumed without investigation or proof.

That this assumption is quite unscientific, and that it is liable to lead to erroneous results, does not need to be argued before the careful meteorologist. The difference in the rules and methods of observation and the spirit of the observers, as well as the difference in the locations and exposures of the gauges and in the gauges themselves, furnish abundant room for systematic discrepancy.

With the record thus constructed out of the two series of observations, an average increase of seven inches seemed to have occurred during the past twenty years, and this result has been widely used to confirm the belief in a permanent increase in the rainfall over the Western plains. For the reasons above stated, this conclusion seems to me to stand in need of a complete re-examination. In a preliminary survey of the Fort Leavenworth observations as printed, errors were discovered that showed the necessity of a thorough scrutiny of the original data (see *Science*, xi. No. 272).

In order to make the desired examination, I have visited Fort Leavenworth, and through the courtesy of Major Alfred A. Woodhull, Surgeon U.S.A., was enabled to make copies of the original records for the years not hitherto published, and for the periods needing confirmation. I am also indebted to Major Woodhull for certified copies of a portion of the records that have heretofore been incorrectly printed.

In view of the error already discovered, — namely, that the measured snowfall in January, 1871, had not been reduced to inches of

water, — I examined all of the data since 1870, to correct, so far as possible, all other errors of the same kind. The record of snow for the winters of 1870–71 and 1871–72 were found to be given in this way, and comparison with the Signal Service observations also indicated that the reduction had been neglected in a few instances in subsequent years. This critical examination of the original observations has led to the construction of the accompanying table of monthly totals: —

MONTHLY PRECIPITATION AT FORT LEAVENWORTH, KAN.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1870......	—	—	—	—	—	—	—	—	—	—	—	1.27*	41.70
1871......	1.12	3.37	1.70*	1.22	2.00	5.44	1.63	4.66	1.85	4.00	3.94†	0.46	31.39
1872......	0.20	0.87†	2.30	4.50	8.15	3.64	9.99†	6.83	4.05	0.83	0.00	2.85	44.21
1873.	0.98	1.35	1.80	4.30	5.03	3 11	3.12	1.40	2.53	0.91	0.87	5.24†	30.64
1874......	1.44	1.07	1.50	1.40	1.00	3.55	2.95	1.69	4.76	0.37	3.46†	1.02	24.21
1875......	0.05	1.25†	1.70	2.23	4.17	2.34	6.72	3.15	0.78	0.74	0.40	1.98	25.51
1876......	1.20	0.44	5.71	6.19	6 17	4.81	2.28	4.21	3.62	3.00	1.91	0.66	40.20
1877......	1.65	0.58	4.14	5.16	7.61	7.59	4.36	2.15	1.88	4.36	1.71	2.82	44.01
1878......	1.36	2.88	1.95	2.76	3.96	4.36	1 89	2 38	2.61	0.54	2 28	2 40	29.37
1879......	0.12	0.35	0.06	3.44	2.05	7.89	3.59	0.62	2.79	3.85	6.26	1.85	32.87
1880......	2.14	1.55	2.53	1.46	3.90	0.96	5.86	6.68	1 68	2.40	1.80	0.40†	31.36
1881	0.15	4.61	2.20	1.67	3.14	3 73	2.00	1.92	5.23	4.46	1.40	0.96	31.47
1882......	1.07	0.88	0.76	3.84	2.61	2 82	3.00	0.65	1.18	2.28	1.92	1.06	22.07
1883......	0.48	2.05	0.72	1.27	6.65	12 16	2.25	1.97	0.85	8.31†	2.02†	0.65†	39 38

* Observations by Mr. F. Hawn. † Observations by Signal Service.

Important changes in the values for April, May, July, and August, 1871, are corrections of serious errors existing in the published observations, the corrected values having been furnished by Major Woodhull. For those months in which the record at the fort is missing, namely, February and July, 1872, and October to December, 1883, the Signal Service observations have been inserted to complete the series.

The Signal Service record has also been substituted in November, 1871, and December, 1880, — months in which the fort record is manifestly recorded improperly, but for which the correct record cannot safely be inferred; and also in December, 1873, November, 1874, and February, 1875, for portions of which the fort record of snow is apparently measured carelessly, or recorded without reduction, but of whose error the evidence now at hand is not entirely conclusive.

Although in these several instances the fort record has been completed by the use of Signal Service observations, the series still remains essentially homogeneous and comparable from 1837 to 1883.

Combining the whole series in ten-year means, we have the material for ascertaining the existence of any secular change: —

Period.	No. of Years.	Amount.
1837–46..................	10	30 4
1847–56............. ..	10	32.3
1857–65..................	9	33.7
1867–76	10	33.2
1877–83..................	7	32.9

The increase of seven inches shown by the combined Fort Leavenworth and Signal Service records has largely disappeared. Examining, now, the average annual rainfall from 1872 to 1883 given by the Signal Service record and the record at the fort, we find that the former is 38.5 inches, and the latter 33.0 inches, showing a discrepancy between the two of five and a half inches.

To what this discrepancy is due, — whether to differences in the rules of observation or to an error of ten per cent in the Signal Service gauge (as was the case at Providence, R.I.), or to some other cause, — I do not know; but it is fairly manifest that the conclusions based on the assumed comparability of the two series are quite worthless.

GEO. E. CURTIS.

Birmingham, Conn., June 30.

Photographs of Lightning-Flashes.

POSSIBLY some of your readers may be interested in the following report: —

In the month of June, 1887, a committee of the Royal Meteorological Society, London, issued about two hundred circulars to the secretaries of photographic societies in various parts of Europe and America, and also to other likely persons, requesting them to furnish the society with photographs of lightning-flashes.

About sixty photographs of lightning-flashes were received in answer to this invitation; and these were exhibited at the meeting of the society in March, 1888, where they received much attention.

From the evidence now obtained, it is evident that lightning assumes various typical forms, under conditions which are at present unknown.

The following appear to be some of the most typical forms of lightning-flashes: —

1. Stream lightning, or a plain, broad, rather smooth streak of light. Only two or three specimens of this form have been received. The committee are disposed to consider this a distinct type of a single stream-like character, without distinct irregularities or branches, and not merely the result of bad focusing, because other objects, such as trees, are extremely sharp.

2. Sinuous lightning, when the flash keeps in some one general direction, but the line is sinuous, bending from side to side in a very irregular manner. This is by far the commonest type.

It is very noticeable that the thickness of the line varies during the course of discharge. Sometimes the thinnest part of the white streak is the highest, and the flash appears to get thicker as it approaches the earth; at other times a flash in the air begins thin, broadens out in the middle, and fines away again at the farther extremity.

The committee can offer no explanation of this at present, but they would call attention to the fact, that, in some photographs of electric sparks taken from an induction-coil, those of high tension are thinner than those of low tension.

3. Ramified lightning, in which part of the flash appears to branch off from the main streak like the fibres from the root of a tree. Of course, there is no evidence as to whether these fibres branch off from, or run into, the main flash.

4. Meandering lightning. Sometimes the flash appears to meander about in the air without any definite course, and forms small, irregular loops. The thickness of the same flash may vary considerably in different parts of the course, as mentioned above; and a flash may go pretty straight in one portion of its path, but meander considerably in another.

5. Beaded or chapleted lightning. Sometimes a series of bright beads appear in the general white streak of lightning on the photographic plate. Occasionally these brighter spots appear to coincide with bends in a meandering type, but often the beads appear without any evident looping of the flash.

But as a flash is moving in space, while two directions only can be shown on the plane of the paper, there is every reason to believe that the brighter spots on the positive picture may be points where the flash was zigzagging, either directly towards, or away from, the observer, and thereby giving a somewhat longer exposure to these spots.

6. Ribbon lightning. Nearly one-sixth of the photographs received by the society show flashes exhibiting more or less of a ribbon-like form. One edge of the ribbon is usually much whiter and firmer than the other.

Occasionally in the same picture some flashes appear normal, and others ribboned; but the flashes in a picture need not have occurred simultaneously. The committee have not yet in their possession any conclusive evidence as to whether the same flash may be normal in one portion, and ribboned in another portion, of its course.

In one picture there is a bright streak on the top of the flash; then about an eighth of an inch of ribbon-like light, the folds fol-

lowing the sinuosities of the bright streak; then a dark band, parallel to, and following, every irregularity of the bright streak; and then nearly another eighth of an inch of ribbon-like light. In another picture a very thin beaded flash has a precisely similar beaded streak, rather fainter than itself, running parallel to it, at a distance of about a sixteenth of an inch on the paper.

It might be suggested that the second fainter image was formed by internal reflection from the back surface of the glass plate; but it should be noticed that sometimes very thin flashes, which are not particularly bright, are so duplicated.

A far more probable cause is the double image formed by the internal reflections of doublet photographic lenses. All doublets are essentially two meniscus lenses, mounted with their concave surfaces facing one another. The greater portion of a strong point of light, passing through both lenses, forms the usual image on the plate; but a smaller portion is reflected from the concave surface of the rear meniscus on to the concave surface of the front lens, and from thence back through the rear lens to the sensitive plate. The amount of displacement depends on the angle formed between the direction of the bright point and the optical axis of the lens.

M. C. Moussette of Paris showed some photographs of the sun in which this double reflection image was very conspicuous; and there is not the slightest doubt that some lightning-flashes are bright enough to give this secondary image. M. Moussette also showed the photograph of a flash in which the centre of the flash was whitest, with a darker edge on either side. This may have been produced either by double reflection from the lens, or by internal reflection from the back of the glass plate. Two bands of light — the primary and secondary images — slightly overlapping would form an extra bright band where the overlap took place.

In the majority of cases, the folds of the ribbon formation are most obvious when the course of the flash is square to the width of the folds, and they are but slightly pronounced when in a line with them. This would suggest the idea of a shaking of the camera in the direction of the folds of the ribbon; but, if this is so, the duration of a lightning-flash must be much longer than is usually supposed.

The committee hope to have the opportunity of making some experiments on the photography of sparks from a coil or electrical influence machine. In the mean time they defer expressing an opinion as to whether lightning ever really takes a ribbon-like form till further evidence is available, but would point out that both sources of error — the duplication of the image either by reflection inside the lens, or by reflection from the back of the plate — would be avoided by the use of single lenses, and of paper instead of glass supported films. The committee also forbear for the present from publishing a reproduction of a ribbon-like flash, till they are satisfied that such a form of lightning really exists, and that the whole appearance is not due to photographic causes.

In one picture, sent by Mr. Shepherd, there are five ordinary white flashes, and one dark streak of precisely the same character as the bright streaks. M. Moussette has suggested that this may be the result of a very bright flash, so over-exposing the plate as to produce the well-known inversion of a negative by over-exposure, as when the ball of the sun appears black on the positive print, instead of white. This is no doubt a possible explanation; but the committee would like further examples of this same appearance of dark flashes before expressing an opinion on the matter.

The committee call attention to the fact that there is not the slightest evidence in the photographs of lightning-flashes of that angular zigzag or forked form so commonly seen in pictures.

In connection with this, they would call attention to a remarkable paper, communicated to the British Association in 1856, by James Nasmyth, F.R.S. Mr. Nasmyth says that he has never seen forked lightning of the angular zigzag form, and asserts that "the true natural form of a primitive flash of lightning appears to Mr. Nasmyth to be more correctly represented by an intensely crooked line, and on several occasions he has observed it to assume the forked or branched form, but never the zigzag dovetail."

The Council of the Royal Meteorological Society are desirous of obtaining more photographs of flashes of lightning, as they believe that a great deal of research on this subject can only be pursued by means of the camera, and would esteem it a great favor if any one would give them any assistance in this matter, either by sending them copies of any photographs of flashes of lightning that may have already been taken, or by endeavoring to procure them, or to interest others in so doing.

It may perhaps be well to mention that the photography of lightning does not present any particular difficulties. If a rapid plate, and an ordinary rapid lens with full aperture, be left uncovered for a short time at night during a thunder-storm, flashes of lightning will, after development, be found in some cases to have impressed themselves upon the plate. The only difficulty is the uncertainty whether any particular flash will happen to have been in the field of view. A rapid single lens is much more suitable than a rapid doublet; and it is believed that films on paper would effectually prevent reflection from the back.

The focus should be that for a distant object; and, if possible, some point of landscape should be included to give the position of the horizon. If the latter is impossible, then the top of the picture should be distinctly marked. Any additional information as to the time, direction in which the camera was pointed, and the state of the weather, would be very desirable. The council hope, now that the thunder-storm season is approaching, many photographers, both amateur and professional, may be found willing to take up this interesting branch of their art. A. F. N.

New York, July 2.

The Name of America.

WILL you permit us to correct some erroneous ideas in your note on our work? Your reviewer, referring to the origin of the name 'America,' says that our account derives it from a Peruvian tribe, although the name was in use long before Peru was discovered. This, no doubt, is an unintentional misrepresentation, as no such tribe ever existed, the name 'Peru' having been given by the Spaniards to the kingdom of the Aymaras of Aymaraca, whose subjects, according to some authors, were also the chief race in the West Indies. Your reviewer also wonders if the author ever knew that the Indies was the recognized Spanish name of the continent during the age of its discovery.

It seems to us incredible that any one could make such a remark, seeing that every schoolboy knows the story of the naming of the West Indies, while our work refers over and over again to the fact that the continent was officially known in Spain as the Indias, — a general term including the East and West Indies, which contained a large number of countries.

When a work bases a discovery on the evidence of standard authorities, the impartial critic who is not convinced will point out where the evidence is defective. This is the law of logic, which a scholar cannot ignore. But when an author who translates his original evidence from Italian, Spanish, French, German, and Latin, finds himself designated under the clownish epithets of 'half-learned wanderers,' 'happy enthusiasts,' 'erratic followers,' etc., we will leave it to the public to say whether that is an impartial, fair, or scholarly critique, or whether it does not look like the work of some little publisher, whose history — always for sale — tells another story.

The great Baron de Humboldt says that Amaraca-pana was the first Spanish settlement on the mainland. This was in 1502, five years before the pamphlet of St. Die proposed the name of 'Amerigo Vespucci,' who sailed into Amaraca-pana on his first visit, under command of Ojeda, to the New World, and which was the only place where they were favorably received, and treated as if they were angels. So says the royal Spanish historian Herrara, in quoting Ojeda himself; and the Isle of Tamaragua, on the first standard map of the continent, published in 1508, was evidently intended for Amaraca or America, which was long considered an isle. Here is positive evidence, by well-known authorities; and whoever is not convinced should point to evidence of a better explanation, or show cause why ours is insufficient; doing so in the language — to use your reviewer's own words — of a "sober historian." T. de St. Bris.

New York, June 30.

[Our correspondent has evidently failed to read the review carefully.— Ed.]

Bishops Potter, Stevens, and Robertson; Presidents Mark Hopkins, Hitchcock, and Barnard; Profs. Parker, Draper, and Beard; and thousands of the world's best brain workers, have used and recommended CROSBY'S VITALIZED PHOSPHITES, for the relief of Nervous Derangements, Brain Weariness, Dyspepsia, and Debility.

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SCIENCE

FRIDAY, JULY 13, 1888.

NO SCIENTIFIC REPORT published by the government this year has been more important than that just made by Dr. J. J. Kinyown, assistant surgeon in the Marine Hospital Service, upon the germicidal powers of the different methods of disinfection practised under the direction of the Louisiana Board of Health at the quarantine station below New Orleans. The report is important, not only because it shows the degree of protection against the importation of infectious diseases through the important port of New Orleans; but also, since the methods of disinfection practised at other quarantine stations are similar to those in use there, the experiments show approximately the efficacy of each mode of disinfection, and suggest changes that should be made in their use. The three methods of disinfection tested were by the use of bichloride-of-mercury solution, the application of dry and moist heat, and fumigation with sulphur dioxide. Dr. Kinyown finds the first of these methods defective, because of the difficulty of getting the disinfecting-agent into cracks and corners, carpets, rubber goods, the under sides of decks, and into lockers, etc. He discovered in all these localities and articles that the micro-organisms existing before the disinfection had not been destroyed, and he found them as plentiful on the floor of the forecastle of one ship, that was exceptionally filthy, after it had been drenched with bichloride of mercury for an hour, as before. Dr. Kinyown recommends, that, in order to make this mode of disinfection more effectual, the bichloride of mercury be applied with a spray produced by a connection with a steam-boiler, and that it be applied after fumigation by sulphur. The results from the application of dry and moist heat were the most satisfactory of all. Cultivations of various disease-germs exposed to a dry heat of 80° C., and afterwards to steam at a temperature of 100° C., were, with few exceptions, destroyed. Dr. Kinyown thinks, that, in order to secure absolute protection, the heat should be made greater and the time of exposure increased. In eleven experiments seventy-four disease-germs were placed in vessels among articles to be disinfected by the use of sulphur dioxide, but only sixteen of the whole were destroyed, or less than twenty-two per cent. Dr. Kinyown has very little to say about this method of alleged disinfection, except to recommend that the sulphurous fumes be applied in larger quantities, and confined in the compartments to be disinfected a longer time. But he reports his experiments in full, and lets them speak for themselves. The net result of these tests is to show that some disease-germs escape even when the most effectual modes of disinfection practised at quarantine below New Orleans are resorted to, and that less than one-fourth of them are killed when the least effective method is used. We assume that quarantine and city health officers everywhere will profit by the suggestions of this report, and that the public will be better protected in the future than in the past.

AT THE RECENT MEETING of the Massachusetts Assembly of the Agassiz Association in Boston, Prof. W. O. Crosby called attention to the fact that Mr. Harlan H. Ballard, the president of the association, in the 'Three Kingdoms' and elsewhere, has rightly emphasized the importance of studying the local natural history, and explained that this is especially desirable for the department of geology and mineralogy, since the rocks and minerals are in most parts of the country, and especially in New England, much more localized than the fauna and flora. Thus, while the animals and plants must always change gradually from place to place, and may be nearly the same for an entire State, the geological features, the rocks and minerals, change very abruptly, and sometimes completely, as we pass from one formation to another; so that adjoining towns and neighborhoods are sometimes as strongly contrasted in their mineralogy and geology as the most distant parts of the earth. It will be readily seen that where this is true it is particularly desirable that each chapter should give attention chiefly to its own field; and interesting results may be expected from the presentation and comparison, at these annual meetings, of the work done in the different parts of the State. In this way each chapter will gain not only a valuable training in observation, but also that real and satisfactory knowledge of the local geology which can be obtained only through original study; while through the interchange of results and ideas the field is broadened, and the methods of work gradually improved. Professor Crosby spoke further as follows: "During all the time that I have been conducting the lessons in elementary and determinative mineralogy, I have felt that we should realize more fully the ideal plan of work for the Agassiz Association, if I could co-operate with members and chapters in the study of their local geology and mineralogy. Of course, it would be preposterous for any one to propose to do this for the entire organization. Not to mention other difficulties, such as the time required, it would be out of the question for any one specialist to have that detailed knowledge of the geology of the entire United States which would be required for the successful operation of such a plan. The organization of the Massachusetts Assembly has, however, suggested to me that I might, perhaps, be of some real assistance in this direction to the Massachusetts chapters. But, in offering to assist those who are really in earnest, I have no thought, of course, of pre-empting the field, or excluding other geologists. I simply desire to say that I, for one, shall be glad, so far as my time and ability will permit, to render such assistance as may be needed. I can help you sometimes in the determination of specimens; although it is to be hoped, for your own sakes, that you will heed Mr. Ballard's advice to exhaust your own resources before applying for such aid. I can, perhaps, offer useful suggestions as to the best plans for work in particular localities, and may be able to put you in the way of getting the necessary maps, etc., for the representation of your results. Lastly, though I can imagine that Professor Hyatt would advise me to proceed very slowly here, I can often aid you in finding what has been published on the geology and mineralogy of the different sections of the State. I shall, however, be very reluctant to do any thing in this direction in advance of good, original work in the field. The literature of your field would at first, in most cases, be only a hinderance to good work. It is to be hoped that every year you will bring your best results to these meetings, not merely brief reports of what you have worked at, but the work itself. Your principal reward will, of course, be the training and knowledge gained, and the satisfaction of having done good work. But it would be very strange indeed if such an exhibit of a year's results did not reveal something new to science, and worthy of publication; and this is another direction in which we should be glad to lend a hand." No chapter in Massachusetts can afford to neglect so rare an opportunity as Professor Crosby offers. Will not geologists in other States take a hint from this wise and generous method of encouraging this important branch of study in a practical manner?

METHODS OF DISINFECTION.

AT the request of the State Board of Health of Louisiana, that a test be made of the efficiency of the modes of disinfection employed by that board, Dr. Hamilton, surgeon-general of the Marine Hospital Service, detailed Assistant Surgeon J. J. Kinyown, last spring, to make the investigation. Dr. Kinyown's full report is published in the *Weekly Abstract* for June 29, and is so interesting and important that copious extracts from it are given below.

After describing the quarantine station and hospital below New Orleans, at which he arrived May 6, Dr. Kinyown makes full quotations from the brochure of Dr. Joseph Holt, ex-president of the Louisiana Board of Health, entitled 'The Quarantine System of Louisiana: Methods of Disinfection Practised,' to show the manner in which *it is claimed* that the germs of disease are destroyed in the baggage of passengers and crew of vessels, the cabin, deck, hold, and cargo. It is unnecessary even to make an abstract of these passages, since the modes of disinfection used are sufficiently indicated by Dr. Kinyown's own remarks and the reports of the experiments he conducted. It is sufficient to say that three methods of disinfection are described, — that by the application of bichloride of mercury, fumigation with sulphurous oxide, and by applications of dry and moist heat.

"Testing the efficacy of the methods practised and materials used in the disinfection of ships, cargo, and baggage," etc., says Dr. Kinyown, "was with special reference to the germicidal powers for which it is claimed.

"Accordingly, before leaving New York, a large number of cultivation-tubes were prepared, containing blood-serum, peptone gelatine, agar-agar, and rags. A large number of these were inoculated from pure cultivations of the micro-organisms here mentioned; viz., spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis (Hueppe), bacillus murissepticus, bacillus pneumoniæ (Friedlander), bacterium of yellow-fever (Finlay), staphylococcus pyogenes albus, staphylococcus pyogenes aureus, streptococcus erysipelatus.

"Several of the series of above-named micro-organisms were obtained of Dr. T. M. Prudden; also one specimen of the micro-organism claimed to be the cause of yellow-fever, by Dr. Finlay of Havana, Cuba; another of the same organism was furnished by Dr. S. T. Armstrong, who had only a few days prior to my departure received it from Dr. Finlay.

"Whether the organism referred to *is* the cause of yellow-fever, we leave for others to confirm or disprove.

"In carrying out the following series of experiments, it was intended to show whether the process of disinfection applied to such vessels was sufficient to destroy the growth of these micro-organisms; and in but few instances was the process varied or the time lengthened from that which is practised from opening of the quarantine season to June 1, when the time is lengthened to five days. It was also for the purpose of deciding whether the time imposed on vessels prior to June 1 was sufficient for the prevention of epidemic disease.

"In carrying out these experiments, several classes were conducted at the same time, and, to have them correspond with the description of the machinery, etc., the same order will be followed.

"Since the opening of the season, vessels engaged in the fruit-trade, and plying between ports subject to quarantine, are not subjected to the same treatment as others. Should they have any passengers aboard who have with them any baggage or articles of clothing save what they wear, they are compelled to stop at the upper station, where the baggage of passengers, crew, ship's linen, etc., are subjected to the steaming process, while the cabin and deck are washed down with bichloride solution.

"If no baggage is aboard, they are given pratique to the city, where the cargo is discharged, and vessel cleansed by washing the deck and burning sulphur in the hold. The quantity of sulphur used was not learned.

"Whenever practicable, all the surfaces inside the hold of the vessel and between-decks are wetted by a simple ¾-inch hose with nozzle, the rose being dispensed with, as it is claimed that there can be a more thorough wetting accomplished than by its use. This is invariably done before the vessel is treated to sulphur dioxide, in order to delay it as little as possible.

"The flat surfaces of the decks are thoroughly washed with a rose sprinkler, but around among the corners, hatches, or perchance hogsheads of sugar that are sometimes on deck, the process is defective, because a great many places are not reached. The same can be said of the disinfection of the cabin, lockers, etc.: only a partial disinfection is accomplished; for, to wet all surfaces, with the present arrangements it would be necessary to almost submerge them with the solution. The carpets, rugs, rubber and leather goods, trunks, and valises are sprinkled with the same bichloride solution.

"Several experiments were made upon the goods, clothing, and surfaces thus treated; and it was found that the solution did not cover all the surface, for portions of carpets, scrapings from floor and under side of the forecastle, deck, etc., when placed upon sterilized nutrient media, showed evidences of germ-development. No apparent difference could be noticed between portions removed from the floor of the forecastle after being saturated for one hour with the bichloride, and other portions of the same that had not been reached by the solution. The last can be explained by the fact that the forecastle was in an extremely filthy condition, and, there being such an abundance of organic matter, the bichloride was rendered inert.

"For the general application of this solution to the ship, especially to cabin, carpets, etc., we suggested that a spraying apparatus be substituted, made by leading a rubber hose from the boiler of the tug, and connecting it with the supply-pipe of the bichloride solution in such a manner as to make a 'Richardson's spray-producer' on a large scale, so that by its use all surfaces, cracks, etc., can be thoroughly and evenly wetted.

"Former experience teaches that placing dirty and greasy clothing in the heating-chamber is not a safe procedure with the present apparatus, for to them have been traced the cause of fires breaking out during the steaming process. They are now left on deck and sprinkled with bichloride of mercury, in the following manner: One attendant stands ready with hose in hand, while another places the clothing to be thoroughly wetted down on the deck, turning them over from time to time, while the other plays a stream of bichloride upon them.

"The car upon which the clothing, bedding, goods, etc., is placed for the purpose of transporting them to the steam-heating chamber is not disinfected before the goods are placed upon it to be taken back to the ship."

Seven tables are given for the purpose of showing the variations of temperature obtained in the heating-chamber, and Dr. Kinyown then proceeds to give detailed reports of the experiments he made. The first series was for testing the applications of dry and moist heat. He says: —

"I was informed by Dr. Aby that his instructions from the board of health were to the effect that clothing, bedding, etc., after being placed within the chamber, should be raised to a temperature of 85° C., after which the steam should be turned on, and kept for twenty minutes after the thermometer indicates 100° C. This manner renders fire less imminent. The time of exposure of micro-organisms to the heating process was not varied from the prescribed rules, save in two instances.

"Cultivations of micro-organisms on various substances were placed, in each of the following experiments, in positions where the minimum heat was to be expected.

"EXPERIMENT NO. 1. — Cultivation-tubes of peptone agar-agar inoculated with spirillum choleræ Asiaticæ, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacterium of yellow-fever (?), were placed in a wire basket and hung in the compartment most distant from the boiler, and upon which but little clothing was hung. In sixteen minutes the temperature (dry heat) reached 79.4°, when steam was turned on and kept twenty minutes, cultivations removed, and inoculations made therefrom, the temperature being ascertained by placing a self-registering thermometer upon the surface of agar-agar within the cultivation-tubes. Repeated examinations show all growths to have been killed.

"EXPERIMENT NO. 2. — Cultivations of spirillum choleræ Asi-

aticæ on blood-serum, bacillus anthracis on agar-agar, bacillus typhi abdominalis on agar-agar, bacillus coli communis on agar-agar, bacillus pneumoniæ on agar-agar, bacterium yellow-fever (?) on agar-agar, staphylococcus pyogenes albus on blood-serum, staphylococcus pyogenes aureus on blood-serum, were suspended in among blankets and mattresses in a compartment near the boiler. A quarantine thermometer registered 88.8° dry heat in central chamber. Steam turned on, and kept forty-three minutes. Temperature among blankets fell to 82.5°. Inoculations made from these cultivations into peptone gelatine showed the bacillus anthracis and bacterium yellow-fever alive: all others were dead. The temperature was taken on the outside of the cultivation-tubes.

"EXPERIMENT NO. 3. — Chamber filled with goods, consisting chiefly of bedding and clothing of the crew. The articles were not hung closely together, as the chamber was filled to only three-quarters of its capacity. Cultivations of spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus pneumoniæ, bacillus typhi abdominalis, bacillus coli communis, bacterium yellow-fever (?), staphylococcus pyogenes albus, staphylococcus pyogenes aureus, were placed in a basket and arranged upon and between mattresses. Thermometers being placed among cultivations, temperature registered 85.5° C. dry heat in centre chamber. Steam turned on, and allowed to remain twenty-seven minutes. All micro-organisms dead except those of bacillus anthracis and bacterium yellow-fever. Thermometer among cultivations indicated 95.5° C.

"EXPERIMENT NO. 4. — Chamber partially filled, compartment containing principally the mattresses and clothing of the crew. A hair mattress was opened, and tubes containing cultivations of spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacterium yellow-fever, bacillus murissepticus, staphylococcus pyogenes albus, staphylococcus pyogenes aureus, were placed within, and exposed to moist heat for twenty-five minutes. A self-registering thermometer placed among tubes indicated 75°. Examination of growths showed those of bacillus anthracis, bacillus murissepticus, and bacterium yellow-fever to be alive: all others were killed.

"EXPERIMENT NO. 5. — Chamber well charged with goods. A series of cultivation-tubes containing rags (both cotton and woollen) that had been inoculated with bacillus anthracis, bacillus typhi abdominalis, bacillus pneumoniæ, staphylococcus pyogenes albus, staphylococcus pyogenes aureus, were placed in among mattresses and blankets, and exposed for twenty minutes to moist heat. Temperature indicated, 62.5° C. Examination showed all growths dead save that of anthrax.

"EXPERIMENT NO. 6. — Clothing and bedding of steamship 'Saturnina,' from Cuba to New Orleans, placed in heating-chamber; all compartments filled. Owing to the uncleanness of the crew's bedding, we suggested that a longer time be given in the steaming process. Cultivations on agar-agar of spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus typhi abdominalis, bacillus pneumoniæ, bacillus coli communis, staphylococcus pyogenes albus, staphylococcus pyogenes aureus, were placed in the compartment, arranged on mattresses, and surrounded by pillows. Temperature of middle chamber (quarantine thermometer), 76.6° C. Left for fifty-five minutes. Thermometer among cultivations indicated 67°. Inoculations show all killed except bacillus coli communis and bacillus anthracis.

"EXPERIMENT NO. 7. — Chamber was lightly charged, several panels in each compartment being empty. Cultivations made upon rags of the following: spirillum choleræ Asiaticæ, bacillus typhi abdominalis, bacterium yellow-fever, staphylococcus pyogenes albus, staphylococcus pyogenes aureus. These were suspended among clothing, chiefly underwear, and allowed to remain forty minutes. A thermometer placed in a tube containing similar media registered 99°. Inoculations from the tubes show that all have been killed except the bacterium of yellow-fever.

"EXPERIMENT NO. 8. — Chamber filled with goods, — bedding and clothing. Cultivations of spirillum choleræ Asiaticæ, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacterium yellow-fever, staphylococcus pyogenes albus, were placed in heating-chamber, in its centre, arranged upon blankets and clothing. These were subjected to moist heat for forty minutes. Temperature indicated near cultivations was 69°. The bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, and staphylococcus pyogenes albus were found to be alive.

"The quantity of sulphur consumed in the fumigation of each vessel is from 100 to 400 pounds, according to the size of the vessel. Those arriving at quarantine during our stay at the station varied from 100 to 2,000 tons burden. About 100 pounds of sulphur are consumed in an hour, and form about 1,170 cubic feet of sulphur dioxide. If, as is claimed, 180,000 cubic feet of air per hour be driven into the hold or compartment of a vessel, the strength of the gas would be approximately .6 per cent.

"That that quantity of air is not driven into the hold is proven by the fact that in quite a number of volumetric analyses, made on various vessels at the close of fumigation (for the purpose of determining the quantity of sulphur dioxide present), it was shown that there are from 2 to 6 per cent to the 100 pounds of sulphur, the capacity of the compartments being about the same, viz., 20,000 cubic feet. This does not represent the full amount of the gas generated, for in all vessels there is constantly present a certain amount of moisture, which absorbs the gas.

"In the generation of the sulphur dioxide there is formed in the 'battery' a certain amount of nitrous oxide, and, the gas being quite hot (130°) as it enters the vessel, every factor is present for the rapid production of sulphuric acid. The greatest percentage of gas was found in holds containing coffee, still less in sugar, and least in those vessels that had been treated with the bichloride solution previous to fumigation. In these the percentage was notably diminished (2 per cent), the gas being absorbed by the wetted surfaces, also uniting with the mercuric salt, forming a compound which impairs germicidal power of both, and destroys penetrating properties of the gas.

"We were informed that it was the custom formerly to put the exhaust-fan in operation for an hour before, driving pure air into the hold, thus aerating the vessel and cargo before fumigation was commenced. This was not put in practice during our stay. Vessels hailing from ports known to be infected are treated to a larger quantity of gas, 200 pounds or more of sulphur being used to each compartment.

"In testing the germicidal power of the fumigating process it was for determining whether the short time of detention practised prior to June 1 was of sufficient duration to insure complete disinfection of vessel and cargo.

"Where the compartments are empty or communicating with the engine-room or chain-locker, the hatches are not sealed by the customs authorities, and there is no assurance that the sulphur fumes remain longer than a short time after the disinfection is finished.

"It was noticed in several instances where the forward hatch communicated with the chain-locker or engine-room, that the hatches were removed immediately after fumigation, and a wind-sail put in place for the purpose of driving out the fumes, so as to enable the vessel to leave for New Orleans as soon as possible.

"Vessels having their hatches sealed are insured of at least fifteen hours' disinfection. The forecastle, after being thoroughly wetted with bichloride solution, is treated to the 'pot plan,' the longest period of time being three hours, after which it was immediately permitted to be thrown open by the crew. The following experiments were made: —

"EXPERIMENT NO. 1. — Spanish bark 'Pedro,' from Havana to New Orleans. Thoroughly wetted down with bichloride solution. A basket containing cultivations on agar-agar that had been inoculated fifteen days previously with spirillum Finkler-Prior, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacterium yellow-fever, was placed about sixty feet from the hatch, where the fumigating-pipe enters. The cotton plugs were removed from the test-tubes. These were left for a period of ninety minutes, the time occupied in the fumigation. One hundred and fifty pounds of sulphur were used. Inoculations made from time to time from these tubes show that all the growths were not influenced by the exposure.

"EXPERIMENT NO. 2, SO_2. — Steamship 'Morgan.' Rear hold compartment filled with sugar in sacks. A basket containing cultivations prepared for exposure was placed in the hold about six-

teen feet distant from the hose leading into the compartment; tubes containing spirillum Finkler-Prior, bacillus anthracis, bacillus pneumoniæ, bacillus murissepticus, bacterium yellow-fever (?), staphylococcus pyogenes albus, staphylococcus pyogenes aureus. Time of exposure, two hours and twenty minutes. One hundred and fifty pounds of sulphur used. Owing to the character of cargo, no bichloride solution was used. Inoculations made from growth of each micro-organism show no effect upon them.

"EXPERIMENT NO. 3, SO_2. — Two baskets were prepared for placing in the forward hold of steamship 'Morgan;' capacity, 101 tons; cargo of sugar in bags; basket No. 1 containing cultivations of spirillum choleræ Asiaticæ on blood-serum and rags, bacillus coli communis on agar-agar, streptococcus erysipelatus on blood-serum; basket No. 2, spirillum Finkler-Prior, bacillus anthracis, bacillus coli communis, bacillus pneumoniæ, bacterium yellow-fever (?).

"Basket No. 1 placed fifteen feet from pipe; basket No. 2, thirty feet from pipe. Cultivations exposed for one hour and twenty minutes; fumigation lasted one hour. About 100 pounds of sulphur used. Cultivations had to be removed, as the vessel was ready to leave the dock; forward hatch was not sealed. All cultivations alive; no inhibitory effect noted.

"EXPERIMENT NO. 4. — Steamship 'Floridian,' from Colon to New Orleans, having but little freight; several compartments empty. Cultivations of spirillum choleræ Asiaticæ on blood-serum, spirillum Finkler-Prior on blood-serum, bacillus anthracis on agar-agar, bacillus typhi abdominalis on agar-agar, bacillus murissepticus on blood-serum, bacillus cholera nostras on agar-agar, staphylococcus pyogenes albus on agar-agar, staphylococcus pyogenes aureus on agar-agar, were placed in forward compartment (empty). Compartment fumigated for two hours, and allowed to remain for eight hours and thirty minutes. Inoculations were made from time to time, and it was found that those of choleræ Asiaticæ, Finkler-Prior, staphylococcus pyogenes alba and aureus, and bacillus murissepticus, were dead. No effect was noted in any way upon anthrax, typhoid, and cholera nostras.

"EXPERIMENT No. 5. — Cultivations prepared by placing a small quantity of sterilized cotton in test-tubes, and moistening it with a small quantity of distilled water. The cotton was then infected with several growths of the following: spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus coli communis, bacterium yellow-fever (?), staphylococcus pyogenes albus, staphylococcus pyogenes aureus.

"These were placed in an empty compartment that had been thoroughly washed down with the bichloride solution. About 125 pounds of sulphur used. Volumetric examination of gas shows 8 per cent. Time cultivations were exposed, three hours and fifty minutes. Only that of choleræ Asiaticæ was killed.

"EXPERIMENT No. 6. — Cultivations on agar-agar, made only twenty-four hours before, of spirillum choleræ Asiaticæ (2), spirillum Finkler-Prior, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacillus pneumoniæ, bacterium yellow-fever (?), staphylococcus pyogenes albus, staphylococcus pyogenes aureus; also cultivations on cotton and woollen rags of spirillum Finkler-Prior, bacillus coli communis, bacillus pneumoniæ, bacillus typhi abdominalis, bacillus murissepticus, staphylococcus pyogenes aureus, streptococcus erysipelatus.

"Both series were placed in the forward compartment of steamship 'Lizzie Henderson,' a small steamer plying between Tampa and New Orleans. After fumigation the hatch was battened down, and the cultivations left until the vessel arrived in New Orleans, when they were taken out and inoculations made therefrom into fresh agar-agar. Time of exposure, twenty-four hours. Of the growths upon agar-agar, those of bacillus pneumoniæ, Finkler-Prior, and choleræ Asiaticæ were killed. None of those on rags affected.

"EXPERIMENT No. 7. — Cultivations made twenty-four hours before, upon the surface of agar-agar, of spirillum Finkler-Prior, spirillum choleræ Asiaticæ, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacillus pneumoniæ, bacterium yellow-fever (?), placed in forward hold of steamship 'Hutchinson,' down under bags of sugar. Fumigation for one hour and twenty minutes; then hatch closed. Fifteen hours later, while proceeding to the city, the hatch was thrown open; and nine hours thereafter, on arrival in New Orleans, the basket was removed. All germs found living.

"EXPERIMENT NO. 8. — Potato placed in large test-tubes, and inoculated with spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacillus pneumoniæ, bacterium yellow-fever (?), staphylococcus pyogenes aureus.

"These were placed in a basket, and wrapped in an old mattress, which was lowered into an empty compartment of the steamship 'Saturnina.' Fumigated for two hours. 200 pounds of sulphur used. The mattress was taken out four hours after. All growths dead except anthrax, typhi abdominalis, staphylococcus pyogenes aureus, cholera nostras, and yellow-fever. Test-tubes containing agar-agar and gelatine show that the gas in the above-mentioned time penetrates to the depth of three-quarters of an inch. Percentage of gas, 6 per cent. Hatch sealed by customs-officer.

"EXPERIMENT NO. 9. — Recent cultivation on agar-agar, of spirillum choleræ Asiaticæ, spirillum Finkler-Prior, bacillus anthracis, bacillus coli communis, bacterium yellow-fever (?), staphylococcus pyogenes albus, were placed in hold of bark 'Antonio Georgio,' in ballast, from Havana to New Orleans. Ballast and interior of hold well washed down with bichloride solution. Fumigation, an hour and a half. 150 pounds of sulphur used. Time of exposure, two hours. No effect on the organisms.

"EXPERIMENT NO. 10. — A basket containing surface cultivations on agar-agar, of spirillum choleræ Asiaticæ, bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, bacillus murissepticus, staphylococcus pyogenes albus, bacterium yellow-fever, was placed in forward compartment of steamship 'Inventor,' down under bags of coffee, being well covered up. Fumigation lasted four hours. 275 pounds of sulphur consumed. Hatch was then closed for seven hours, when it became necessary, on account of the chain-locker communicating with the compartment, to open the hatch and place wind-sail in position, in order to drive out the gas, so that anchor could be raised. The basket was removed on arrival in New Orleans, twenty hours after, at which time the fumes were still quite strong. Examination showed all cultivations to be alive, though slight inhibitory effect was noticed.

"Cultivation-tubes containing agar-agar and gelatine that were exposed at the same time to SO_2 completely inhibited the growth of all micro-organisms tested.

"EXPERIMENT NO. 11. — Cultivations on agar-agar, of spirillum choleræ Asiaticæ, bacillus anthracis, bacillus typhi abdominalis, bacillus murissepticus, staphylococcus pyogenes albus, placed in rear compartment of steamship 'Inventor,' at a point farthest from the entrance of SO_2. Cargo, sugar. Fumigation for four hours and thirty minutes. 300 pounds sulphur used; hatch then sealed. On arrival in New Orleans, twenty-two hours later, the hatch was opened and an attempt made to remove the basket, but the fumes of the gas were so strong that this could not be accomplished for two hours and a half. Examination of the cultivations showed that all micro-organisms were dead except that of anthrax.

"Cultivation-tubes containing agar-agar and gelatine showed the same inhibitory power as in the preceding experiment.

"EXPERIMENT NO. 12. — A litre of air was collected in sterilized vessels before and after the application of sulphur dioxide. Examination was made for the purpose of determining whether or not the gas exercised a germicidal effect on the micro-organisms of the air in the ship's hold.

"A series was collected that had been exposed one, two, four, and eight hours respectively, samples having been collected previous to application of the gas for the purpose of making control observations. None of the series showed diminution in number.

"EXPERIMENT NO. 13. — Cultivation-tubes containing peptonized agar-agar, gelatine, and rags, exposed for one, two, and four hours, show a decided inhibitory effect on all micro-organisms that were tested. Those exposed for six, eight, and twenty hours to sulphur dioxide killed all non-spore-bearing germs.

"It has been our intention to show by the foregoing observations upon the methods practised in carrying out the present system of quarantine at this station whether or not it is efficient; if not, to show its defects, and how remedied.

"In the evolution of such an establishment, the many difficulties that must have stood in the way of such an undertaking, due credit must be given to those gentlemen who formulated the theory and put in practical operation the present system of disinfection.

"From the series of observations made in determining the temperature of the chamber for the application of dry and moist heat, it is clearly shown that the time prescribed is entirely too short when the chamber is filled with goods; more especially is this noticed when the chamber is filled with such goods as blankets, mattresses, and cushions. Unless a longer period of time is given to each charge, it is certain that only a partial disinfection is accomplished.

"It was suggested to Drs. Wilkinson and Aby that the defects of the present style of steaming-apparatus could be best overcome by adopting the application of dry and moist heat under a pressure of from ten to twenty pounds. To accomplish this it would be necessary to have new machinery, — instead of the steaming-chamber now in use, to have constructed a large chamber of boiler-iron, capable of standing at least twenty-five pounds pressure to the square inch, and provided with one bulk-head door that could be properly secured to make it steam-tight, being provided with suitable appliances for ascertaining the temperature in any part of the chamber. In this manner the disinfection by steam and dry heat could be thoroughly accomplished, and much more speedily than at present. Lighter articles, such as clothing, etc., when not too much crowded, received sufficient heat to disinfect them.

"We are informed by the president of the board, Dr. Wilkinson, that the matter was laid before the health board, and it was by resolution decided to remove the present location of the quarantine station to a place farther down the river, in order that there could be complete isolation; and, guided by the result of the experiments undertaken, a heating-chamber capable of sustaining sufficient pressure from within will be erected, thus insuring an equal distribution of heat and the possibility of attaining and maintaining a much higher temperature than at present; also that an order would be given to the resident physician to the effect that the steaming-chamber should not be so heavily charged, and the time of exposure be extended to a sufficient limit to insure a proper degree of heat.

"It is believed that if, before the application of sulphur dioxide to the holds and cargoes of vessels, the holds be thoroughly aerated by means of the exhaust-fan and the use of a greater quantity of sulphur, confining the gas in the vessel, say, a period of not less than thirty-six hours, then the application of the bichloride solution to the hold and between-decks will accomplish a thorough disinfection of the surfaces of vessel and cargo.

"It is shown that in the short process of fumigation prior to June 1 the gas does not penetrate to any depth in such cargoes as coffee, sugar, etc. After June 1, the time of detention being five days, there is insured a thorough application of the gas in its greatest germicidal power.

"The following conclusions may be drawn: —

"1st, That the application of bichloride solution to interior of the cabin, carpets, rugs, trunks, valises, rubber and leather goods, should be made in such manner as to insure the moistening of all surfaces.

"2d, The chamber should not be charged to more than half its capacity, and the time lengthened to at least one hour.

"3d, That the time imposed on vessels that have undergone the fumigating process prior to June 1 should be longer, and the application of bichloride to the interior of the hold should be done after the gas has been confined at least thirty-six hours.

"4th, That the establishment of the present style of apparatus is a great stride in the right direction, and has demonstrated its feasibility and the correctness of the principles involved.

"The president, Dr. C. J. Wilkinson, asserts, that, whatever degree of heat has been obtained, it is certain that no case of yellow-fever has developed on any vessel that has been subjected to this process; a fact, however, which was not uncommon under previous methods."

IT is announced that in October, 1889, the second triennial session of the International Congress of Hydrology and Climatology will be held in Paris.

PROTECTION OF BUILDINGS FROM LIGHTNING.

FROM the time that Franklin flew his kite at Philadelphia, and ascertained beyond cavil the true nature of lightning — from that time to the present, the protection of buildings and ships from its destructive agency has been mainly a matter of detail, and application of the laws of electricity so far as they were known.

For a long time the erection of lightning-conductors was opposed by the religious world as heretical and impious. But first in some Protestant provinces in Germany, and later in France and England, the use of the heretical rods gradually extended.

At some recent meetings of the London Society of Arts, Prof. Oliver J. Lodge has delivered a series of lectures on protection from lightning, in which he has summarized the prevailing opinions of scientific men.

The two main destructive aspects of a lightning-flash are (1) its disruptive, or expanding, or exploding violence; (2) its heat. The heating effect is more to be dreaded when the flash is slow and much resisted; the bursting effect, when conducted well, except at a few places. A noteworthy though obvious thing is, that the energy of the discharge must be got rid of somehow. The question is, how best to distribute it.

That conductors often fail is undeniable. It is customary to say they are not properly made, or that there was a faulty joint, or that there was a bad earth. A bad earth is the favorite excuse. A good earth is a good thing undoubtedly, and one cannot well have too much of it; but for a flash to leave a fine thick copper conductor on a tall chimney while still high up, and begin knocking holes in the brickwork in order to make use of the soot, or the smoke, or some bolts or other miserable conductors of that sort, because it is not satisfied with the moderate allowance of earth provided for it at the bottom, is evidence either of simple perverseness, or else of something more deep-seated and not yet properly called attention to.

If the earth is bad, the flash can show its displeasure when it gets there by tossing it about, and boring holes into it, and breaking water and gas mains; but at least it might leave the top and middle of the chimney alone, it might wait till it got to the badly conducting place before doing the damage. Yet it is notorious that on high chimneys a flash often refuses to follow a thoroughly good conductor more than a quarter or half way down, but takes every opportunity of jumping out of it and doing damage.

It may be said that the effect of the bad earth is to make the whole path so highly resisting that the discharge necessarily declines to take it. Well, if that were so, it need not have come into the conductor at all. It is supposed with one breath to strike the conductor, because it affords an easy path to earth; and with the next it is said to leave the conductor, because, after all, it finds it a bad one.

Besides, it need not be so very particular about a little resistance. It has already come through, say, half a mile of clear air: it might manage a few feet of dry soil. It strikes violently through the air, enters the conductor, and begins to go quietly. Why does it not continue to go quietly till it gets to the bottom of the good conductor, and then begin displaying its vigor by boring holes below, as it has done above? Why should one end have to be so persistently cockered up? Why not insist upon having not only a good 'earth,' but also a good 'sky'?

The old and amusing political controversy between knobs and points has disappeared. Points to the sky are recognized as correct; only Professor Lodge would advocate more of them, any number of them, rows of them, like barbed wire — not necessarily at all prominent — along ridges and eaves. For a point has not a very great discharging capacity. It takes several points to discharge readily all the electricity set in motion by a moderately sized Voss or Wimshurst machine: hence, if you want to neutralize a thunder-cloud, three points are not so effective as three thousand.

An earth is necessary, or you will have your foundations knocked about and your garden ploughed up. A good earth is desirable. A few tons of coke, with the conductor coiled up among it, is a well-known and satisfactory plan if the soil be permanently damp. A bag of salt might, perhaps, be buried with it to keep it damp throughout, or rain-water may be led there. Often, however, the most

violent thunder-storms occur after a spell of fine weather, and the soil is likely to be dry. It is best, therefore, to run your conductor pretty deep, and there make earth.

It is all very well to connect the conductors to water-mains if near; but, if they are far off or non-existent, it is no use; and in no case, in Professor Lodge's opinion, should they be used as sole earths, certainly not gas-mains. In dry weather they are not earthed at all well, and a strong charge may then surge up and down them, and light somebody else's gas in the most surprising way. It does not often happen, but it may happen in sandy soil after dry weather.

It is a superstition to place much reliance on the testing of conductors with a galvanometer and Wheatstone bridge. A galvanometer and Wheatstone bridge are powerless to answer many important questions. A Leclanché cell can no more point out what path lightning will take, than a trickle down a hillside will fix you the path of an avalanche. The one is turned aside by every trivial obstacle, and really chooses the line of least resistance; the other crashes through all obstacles, and practically makes its own path. A flash strikes a house at one corner, rushes apparently part way down the conductor, then flashes off sideways to a roof-gutter, sends forks down all the spouts, and knocks a lot of bricks out. Another branch bangs through a wall in order to run aimlessly along some bell-wires, and then out through a window-frame, and down a spade or something propped up against the wall, to earth. The lightning-tester comes with his galvanometer and Leclanché cell, and reports that the earth of the conductor has one hundred ohms resistance; and the accident is therefore accounted for. But how much resistance would he have found in the paths which the lightning seemed to choose in preference to the one hundred ohms? Something more like a million probably.

Something has been left out of consideration, and something very important too; and until that something is fully taken into account, no satisfactory and really undeniable security can be guaranteed. That something is inertia, — electrical inertia.

The word 'inertia' one uses as conveying a correct general notion of the behavior of an electric circuit to sudden electro-motive forces, — a behavior which is caused by the influence or induction which every portion of a circuit exerts on every other portion. Consider a conducting-rod as analyzed into a bundle of parallel wires or filaments, and let a current be suddenly started in all. The rising current in any one filament exerts an opposing force on all the others; and this self-generated opposition electro-motive force, due to induction between the different filaments of the conductor, exactly imitates the effects of ordinary inertia as observed in massive bodies submitted to sudden mechanical forces.

The term commonly employed to denote the electrical inertia-like effect is 'self-induction,' which is becoming gradually shortened to 'inductance.' Its original form when first dealt with by Sir William Thomson was the 'electro-magnetic capacity' of the circuit.

Now, since electric inertia is due to a mutual action between the filaments into which a conductor may be supposed divided, it is manifest that the closer packed they are, the greater their inertia will be, and that to diminish inertia it is only necessary to separate the filaments and spread them out.

The main count of the indictment against ordinary procedure is, that too much attention has been hitherto paid to conducting-power, and too little to inertia. In fact, it is not too much to say that practically nothing but conductivity has been attended to, or thought of, in the erection of lightning-conductors.

Another way of putting the matter is this. A lightning discharge is essentially a varying current: it manifestly rises from zero to a maximum, and then dies away again, all in some extremely small fraction of a second, say, a hundred-thousandth or thereabouts. But that is not all: there is a certain amount of energy to be got rid of, to be dissipated; and it may easily be that a single rush of electricity in one direction does not suffice to dissipate all the stored-up energy of the charged cloud. If the conductor is highly resisting, a single rush is sufficient; but, if it be well-conducting, it is quite insufficient. What happens then? The same as would happen with compressed air or other fluid rushing out of an orifice. If it is a narrow jet, there is a one-directioned blast; but if a wide, free mouth be suddenly opened, the escaping air overshoots itself by reason of inertia, and springs back again, oscillating to and fro till the stored-up energy is dissipated. Just so is it with an electric discharge through good conductors: it is not a mere one-directioned rush; it is an oscillation, a surging of electricity to and fro, until all the energy is turned into heat.

There is another fact which it behooves us to be aware of. It is one to the importance of which the attention of scientific men has but recently been called. Experimentally it has been discovered by Professor Hughes; theoretically, by Mr. Oliver Heaviside, Lord Rayleigh, and Professor Poynting; for, though the necessary theory is really contained in Clerk Maxwell, it required digging out and displaying. This has now been abundantly done, but the knowledge has scarcely yet penetrated to practical men; indeed, it has not yet been thoroughly assimilated by most physicists. The fact is this. When a current starts in a conductor, it does not start equally all through its section: it begins on the outside, and then gradually though rapidly penetrates to the interior. A steady current flows uniformly through the whole section of a conductor: a variable current does not. It is started first at the surface, and it is stopped first at the surface.

Remembering the rapidly oscillating character of an electric discharge, remembering also the fact that a rising current begins on the outside surface of a conductor, we perceive, that, with a certain rate of alternation, no current will be able to penetrate below the most superficial layer or outer skin of the conductor at all. In the outer skin, of microscopic thickness, electricity will be oscillating to and fro; but the interior of the conductor will remain stolidly inert, and take no part in the action.

Thus we arrive at a curious kind of resistance, caused by inertia in a roundabout fashion, and yet a real resistance, a reduction in the conducting-substance of a rod, so that no portion except that close to the surface can take any part in the conduction of these rapidly alternating currents or discharges. It must naturally be better, therefore, not to make a lightning-conductor of solid rod, but to flatten it out into a thin sheet, or cut it into detached wires. Any plan for increasing surface and spreading it out laterally will be an improvement.

Perhaps it may be as well to guard against one favorite misconception. It has long been known that static charges exist only on the surface of conductors. It has also long been known that ordinary currents flow through the whole section and substance of their conductors. It is now beginning to be known that alternating currents may be sufficiently rapid to traverse only the outer layers of conductors; and this last piece of knowledge is felt to be rather disturbing by those who have been accustomed to dwell upon the behavior of steady currents, and seems like a return to electrostatic notions, and an attempt to lord it over currents by their help. But the first and third facts mentioned above — the behavior of static charges, and the behavior of alternating currents — are two distinct facts, independent of each other; not rigorously independent perhaps, but best considered so for ordinary purposes of explanation.

We have thus mentioned two causes of obstruction met with by rapidly oscillating currents trying to traverse a metal rod. First there is the direct inertia-like effect of self-induction to be added to the resistance proper; the resulting quantity being called by Mr. Heaviside 'impedance,' to distinguish it from resistance proper, for there is a very clear distinction between them. Resistance proper dissipates the energy of a current into heat, according to Joule's law; impedance obstructs the current, but does not dissipate energy. Impedance causes tendency to side-flash; resistance causes a conductor to heat, and perhaps to melt. The greater the resistance of a conductor, the more quickly will the energy of a discharge be dissipated, its oscillations being rapidly damped; the greater the impedance of a conductor, the less able is it to carry off a flash, and neighboring semi-conductors are accordingly exposed to the more danger. Resistance is analogous to friction in machinery; impedance is analogous to freely suspended massive obstruction, in addition to whatever friction there may be. To slowly changing forces, friction is practically the sole obstruction; to rapidly alternating forces, inertia may constitute by far the greater part of the total obstruction, so much the greater part that friction need hardly matter.

This is a fairly accurate popular statement of the direct way in

which self-induction aids resistance proper in obstructing an alternating current. But, in addition to these considerations, there is that other indirect way which we have also mentioned; viz., the fact that conduction of alternating current may be confined to the surface of a rod or wire if the alternations are rapid enough. This cause must plainly increase total impedance; for the total channel open to such a current is virtually throttled, as a water-pipe would be throttled by a central solid core.

But which part of the total impedance does it affect? Does it increase the resistance part, or the inertia part? In other words, does this throttling of a conductor act by dissipation of energy, or by mere massive sluggishness? Plainly, it must act like any other reduction of section: it must increase the resistance, the dissipating-power of a conductor, the heating-power of a current. Hence the resistance of which we have spoken as entering into the total impedance has by no means the same value as it has for steady currents, and as measured by a Wheatstone bridge. It is a quantity greater — possibly much greater — than this; and, in order to calculate its value, we must know not only the sectional area and specific conductivity of the conductor, but also the shape of its section, and the rate of alternation of the current to be conveyed.

We may here note a vigorous controversy, or difference of opinion, between Faraday on the one hand, and Sir W. Snow Harris on the other. Faraday was often consulted about lightning-conductors for lighthouses, and consistently maintained that sectional area was the one thing necessary, weight per linear foot, and that shape was wholly indifferent. Harris, on the contrary, maintained that tube-conductors were just as good as solid rods, and that flattened ribbon was better still. Each is reported to have said that the other knew nothing at all about the matter. Of course, we know that Faraday was thinking of nothing but conduction, and conduction for steady currents. Harris had probably no theoretical reason to give, but was guided either by instinct or by the result of experience. In this particular, Faraday was wrong, and Harris was right.

But, it may be said, have not experiments often been made as to the advantage of tape over rod forms of lightning-conductor, with negative results? Yes, but the point usually attended to is the deflagration of the conductor. Mr. Preece, for instance, with Dr. De la Rue's battery, found ribbon and wire equally easy to deflagrate by the discharge. But we are not examining which form of conductor is least liable to be destroyed by a flash (probably there is not much to choose between one form of section and another, for there is no time for surface cooling): we are examining which form will carry off a charge most easily, and with least liability to side-flash; and here thin ribbon shows distinct advantage over round rod.

It is found that a rod of iron carries off a discharge more satisfactorily than a rod of copper. It would seem as if the poorer conducting qualities of iron enabled the discharge to penetrate deeper, and so to make use of a greater thickness of skin.

But, every one will say, surely iron has far more self-induction than copper. A current going through iron has to magnetize it in concentric cylinders, and this takes time. But experiment declares against this view for the case of Leyden-jar discharges. Iron is experimentally better than copper. It would seem, then, that the flash is too quick to magnetize the iron, or else the current confines itself so entirely to the outer skin that there is nothing to magnetize. A tubular current would magnetize nothing inside it. Somehow or other, the peculiar properties of iron, due to its great magnetic permeability, disappear.

If it turns out to be true that an iron rod does not get magnetized by the passage of a rapidly alternating current, it may be held a natural consequence of the fact that such currents flow mainly in its outer surface, and that such tubular currents have no magnetizing power on any thing inside them.

The magnetizability of iron is no objection to its employment in lightning-conductors. Its inferior conductivity is an advantage in rendering the flash slower, and therefore less explosive. Its high melting-point and cheapness are obvious advantages. It is almost as permanent as copper, at least when galvanized; and it is not likely to be stolen. Professor Lodge regards the use of copper for lightning-conductors as doomed.

It is found that a conductor is more efficient in carrying off a discharge and preventing side-flash, in proportion as its self-induction is lessened; say, by spreading it out into a thin sheet, or cutting it up into a number of wires, or otherwise. But no conductor is able to prevent side-flash altogether, unless it is zigzagged to and fro so as to have practically no self-induction: in that case the side-spark is nearly stopped. But so long as a conductor is straight (and a lightning-conductor must, of course, be straight), so long will there be some tendency to side-flash, however thick it be made. It may be a foot or a yard thick, and yet not stop it. A man touching a lightning-conductor, however well earthed, might perhaps receive a shock sufficient to kill him.

How can this tendency to side-flash be further diminished? To stop a pipe full of water from being burst by a blow given to the water, you will make the pipe elastic. An elastic cushion will ease off the violence of the shock of a water-ram.

Electric inertia was known by the other name of 'self-induction;' electric 'elasticity' is known by the other name of 'capacity.' Increase the capacity — not the thickness or conducting-power, but the electrostatic capacity — of your conductor, and it will be able to carry off more.

The only practicable plan is to expand it over as much surface as possible. A lead roof, for instance, affords an expansion of fair capacity which may be easily utilized; and there should be as little mere rod-projection as possible before some extent of surface begins. Flat sheet for chimneys is better than round rod: it has at least some more capacity, and much less self-induction.

For tall isolated chimneys Professor Lodge would suggest a collar of sheet metal round the top and at intervals all the way down; or a warp of several thin wires instead of a single rod, joined together round the chimney by an occasional woof; or any other plan for increasing capacity and area of surface as much as possible.

As to the liability of things to be struck, several questions suggest themselves: Is a small knob at a low elevation as liable to be struck as a large surface at a higher elevation? Is a badly conducting body as liable to be struck as a well-conducting one? In other popular words, does a good conductor 'attract lightning'?

In answering this question experimentally, one must draw a careful distinction between the case of a flash occurring from an already charged surface, which has strained the air close to bursting-point before any flash occurs, and the case of a flash produced by a rush of electricity into a previously uncharged conductor too hastily for it to prepare any carefully chosen path by induction. The two cases are (1) steady strain, (2) impulsive rush.

Experiment on the liability of things to be struck when the air above them is in a state of steady strain, gradually increased, shows that the flash actually prefers to jump three times as much air to a sharp point, and encounter a megohm resistance, rather than take the short direct path offered by a bigger knob.

By modifying the experiment so as to get an impulsive rush, all bodies are equally liable to be struck if at the same height, and no one is more liable than another: simply the highest is struck if they are at all equally conducting. But by making one bad-conducting, its protective virtue is gone. This is the real objection to a bad earth: it cannot protect well against these sudden rushes.

Sudden rushes are liable to occur: the clouds spark first into one another, and then, as a sort of secondary effort or back kick, into the earth. In these cases the best conducting and highest objects are struck, quite irrespective of any question of points and knobs. Points are no safeguard against these flashes. The point gets struck by a vivid flash. It has no time to give brushes or glows: its special efficacy in preventing discharge exists only in the case of steady action, where the path is pre-arranged by induction. In the case of these sudden rushes, the conditions determining the path of discharge are entirely different. No doubt they have to do with what is called the 'time-constant' of the various conductors.

Electrical oscillations are of considerable interest, and have sundry practical bearings. When a flash strikes a system, the electricity goes rushing and swinging about everywhere for no apparent reason, just as water might surge about in a bath or system of canals into which a mass of rock had just dropped, splashing and overflowing its banks. Just so with electricity. Bell-wires, gas-pipes, roof-gutters, conduct side-flashes in a way most puzzling to the older electricians; and thus gas may get ignited in the most

unexpected places, and passengers in a train may feel a shock because a charge has struck the rails. In powder-magazines it is apparent how dangerous this lawless sparking tendency may be; for even the hinge of a door may furnish opportunity for some trivial spark sufficient to ignite powder. By no means should high rods be stuck up to invite a flash to such places. Build them, or line them, with connected iron, barb them all over the roof, connect them to the deep ground in many places, and but little more can be done.

These electrical oscillations and overflows, which it is easy to set up in a charged conductor, manifestly explain what is known as the 'return-stroke.' This fact — that a discharge from any one point of a conductor may cause such a disturbance and surging as to precipitate a much longer flash from a distant part of it — at once accounts for any 'return-stroke' that has ever been observed.

It is for this reason that it is possible that a tall chimney or other protuberance in one's neighborhood may be a source of mild danger; inasmuch as if it is struck it may be the means of splashing out some more discharges to other smaller prominences, which otherwise were beyond striking distance.

Finally, is it possible for the interior of a thoroughly enclosed metal room to be struck; or, rather, can a small fraction of a lightning-flash find its way into a perfectly enclosed metal cavity, for instance, a spark strong enough to ignite some gun-cotton in a metal-covered magazine which might happen to be struck?

The application of the laboratory experiments to powder-magazines is, that, if any conductor (like a gas-pipe) pass out of the building before being thoroughly connected with its walls, it is possible for a spark to pass from something in the interior of the building to this conductor whenever a flash strikes the building.

The complete and certain protection of buildings from lightning is by no means so easy a matter as the older electricians thought it. In many cases we may be content to fail of absolute security, and be satisfied with the probable safeguard of a common galvanized iron rod or rope. But for tall and important buildings, for isolated chimneys and steeples, and for powder-magazines, where the very best arrangement is desirable, what is one to recommend? Professor Lodge sees nothing better than a number of lengths of common telegraph-wire. He thinks a number of thin wires far preferable to a single thick one; and their capacity must be increased when possible by connecting up large metallic masses, such as lead roofs and the like. But the connection should be thorough, and made at many points, or sparks may result. Balconies, and other prominent and accessible places, should not be connected.

The earth should be deep enough to avoid damage to surface-soil, foundations, and gas and water mains. As to the roof, he would run barbed wire all round its eaves and ridges, so as to expose innumerable points, and the highest parts of the building must be specially protected; but he would run no rods up above the highest point of the building, so as to precipitate flashes which else might not occur, in search for a delusive area of protection which has no existence.

The conductors must not be so thin as to be melted or deflagrated by the flash; but melting is not a very likely occurrence, and, even if it does occur, the house is still protected. The discharge is over by the time the wire has deflagrated. The objection to melting is twofold: first, the red-hot globules of molten metal, which, after all, are not usually very dangerous out of doors; and, second, the trouble of replacing the wire. The few instances ordinarily quoted of damage to lightning-conductors by a flash do not turn out very impressive or alarming when analyzed.

MENTAL SCIENCE.

The Nature of Muscular Sensation.

THE active side of psychic life is represented by movements. The study of the ways and means by which these movements are brought about, are co-ordinated and directed to useful ends, forms one of the most important chapters of physiological psychology; but the elements that enter into conscious motion are so numerous, and so intricately connected, that our knowledge of the process is as yet very defective. It has been well said that the clear and definite statement of a problem is a long step towards its solution. While recent research has not succeeded in definitely explaining the nature of the sensations connected with movements, it has cleared the problem of many misconceptions which had attached to it, and called attention to those points from which a final solution may be expected. M. Binet has recently brought together the various aspects of the problem, and added thereto an ingenious suggestion towards their further elucidation (*Revue Philosophique*, May, 1888).

The first distinction that M. Binet emphasizes is that between the consciousness of a movement and that of the co-ordination of the muscles necessary to make it. The latter does not enter into the psychic aspect of movement at all. We may be, and usually are, unaware of the simultaneous and orderly contraction of the various muscles necessary to perform a useful act, and yet be perfectly able to do the act. It is the mental conception of the finished act that guides the muscles and gives unity to the movement. Our problem deals only with the methods by which we become aware that our muscles have obeyed the mandate of our will.

The simplest source of such knowledge is that obtained through the eye. We know that a movement has been accomplished, because we see it. Again, in speaking, we know that the muscular mechanism of articulation has acted properly, because we hear the resulting sound. The voices of speaking deaf persons are usually harsh, owing to the lack of the corrective power furnished by the ear. But, even with the eyes closed, we have quite a definite knowledge that the desired movements have been performed. The general sensibility, the feeling of effort as shown in the change of respiration, etc., the dermal sensations produced at joints, and the feeling of the shortening of muscles, — all contribute to the result. We are powerless to analyze the several *rôles* played by these factors by observing actions in ourselves; but here pathology helps us out of the difficulty, and shows what psychic factor is deranged when a physiological function is lost, as will be touched upon later. Again, this latter class of sensations can learn to control movements which at first require the aid of vision. Walking is a conspicuous example of such. All these factors have the one point in common, that they act after the muscles have contracted. They are due to impressions proceeding inwardly, centripetally, to the brain, and thus informing us what has been done.

The question has been raised, however, whether we have not knowledge of movement centrifugally before the action takes place; whether we have not an outgoing feeling of expended energy suited to the act in question. This view has been supported by many illustrious names, and it has been negatived with equally good authority. The objectors call attention to the fact that there is such a thing as a motor image formed from former sense-impressions, and that this is sufficient to call up the proper mental antecedent upon which the motion ensues. This tells us how much energy to discharge, leaving the rest of the factors to take effect when the action is done.

Pathology calls attention to cases in which the tactile sensibility is destroyed, hoping to draw important conclusions from the interference that this causes with voluntary movement. When such a patient performs a movement, he has only the visual sensory image to guide him; and, if this be taken away by blindfolding him, what will happen? This is the important test; but it is not unambiguous in its interpretation. Most patients will do an action at command with their eyes closed nearly or quite as well as with their eyes opened, the movements in question being those of an anæsthetic limb. They write with the feelingless hand as well as normally. From this observation we can at once conclude that the power of co-ordinating movements, and the consciousness of the motion, are two different things; for these same patients can have their limbs moved for them without their knowing it, thus showing that the centripetal part is interfered with. Another class of patients, however, are reduced, by closing their eyes, to a condition of almost complete motor impotence. In spite of persistent exhortations, they cannot take one hand in the other, touch their forehead, and so on. The upholders of one side of the question emphasize the former result, arguing that the centripetal sensations are not sufficient to direct motion (for here they are lacking), and thus show the necessity of assuming a consciousness of outgoing energy, an

innervation feeling. Their opponents point out that with the loss of sensibility goes the loss of power to move, making an innervation feeling unnecessary. How can these two classes of facts be reconciled and brought under one law?

In answer to this query, M. Binet has a useful suggestion to offer. It has been shown that among hysterical patients with anæsthetical regions a physical or psychic stimulus increases motor power; acts dynamogenetically, as Féré puts it. May not the opening of the eyes act in the same way with some patients, and this re-enforcement be unnecessary with others? In support of this view is the observed fact that in a patient whose right arm was anæsthetic, and who could not move this arm as desired with her eyes closed, this closure of the eyes had a like effect upon the sound left arm. In both cases the movements were slow, inexact, hesitating, more so with the diseased arm. Intermediate cases occur in which the withdrawal of the eye weakens the power of movement without destroying it, thus showing the characteristic individual variations of this re-enforcing power. Moreover, the movements of anæsthetic limbs have, according to M. Binet, been wrongly interpreted. Although such patients are unaware of passive movements, yet these are physiologically registered in their nervous system. This is shown by the fact that a movement thus passively made by guiding the patient's hand will be reproduced by her voluntarily. She does not know what motions have been made with her hand, but her brain-cells reproduce the same motions. We must admit that movements can be voluntary without being conscious. In conclusion, M. Binet gives the opinion that the supposition of a feeling of innervation acting centrifugally is as yet an ungrounded one, and expects much light from future research.

MEMORY OF MOVEMENTS. — In the *Revue Philosophique* for May, Professor Beaunis describes an interesting series of experiments upon the memory of muscular movements. The experiments form part of a more extended research upon the memory of sense-impressions in general, and are concerned with two questions. The first relates to the accuracy with which the length of lines drawn without the aid of the eyes can be reproduced; the second, to the reproduction of angles under similar conditions. A line is drawn, and, after an interval of from five to fifty seconds, the attempt is made to draw a second line equal to the first, making it with a little stroke to distinguish it from the first. Another method was to make a dot move over a distance and make a second dot; in the reproduction to make a small cross move over an equal distance and make a second cross. In another series two lines were drawn making an angle with one another such as <, and the attempt made to draw another broken line with the same angle. In this test right angles were avoided as being too definite an impression. Care was taken not to have the subject know the results, as this would bring about a more or less unconscious rectification of the errors committed. Professor Beaunis describes his memory as a good one, and mentions that the experiments were made in the evening before going to bed, or when awaking in the night or in the morning, when he was undisturbed by outside noises. The strain of fixing the attention on so minute an impression for more than a few seconds he found very considerable, often inducing feelings of *malaise*. From his observations (to be published in detail later) he draws three general conclusions, confessedly of a tentative character. 1. The memory of the movement does not lapse from consciousness gradually. The memory-image does not fade out little by little, but vanishes more or less suddenly. There is here an analogy with the reverse process, that of recalling a forgotten impression. We have a word on the tip of the tongue, when suddenly it looms into consciousness. 2. When it is no longer possible to recall by a purposive effort the line drawn, — when, for example, one does not even remember whether the angle drawn was acute or obtuse, — the hand will none the less, within a given interval, draw a line closely approximating the original. There is an unconscious memory which in turn loses its accuracy. There is thus a phase of conscious memory, succeeded by a period of unconscious (organic) memory, in turn giving way to a more or less complete forgetfulness. 3. There are sudden variations in the accuracy of the reproductions from one moment to another. These follow no definite law, but are doubtless influenced by variations in subjective conditions.

ELECTRICAL SCIENCE.

Some New Primary Batteries.

AMONG the primary batteries that have lately appeared, two — one an English and one a French invention — deserve special notice. The first of these is an invention of M. Weymersch, and is of the ordinary Bunsen type with zinc and carbon electrodes, the improvement consisting in the employment of a new depolarizing fluid, which greatly increases the constancy of the battery. The Bunsen and bichromate cells give a high electro-motive force; but they are not constant under heavy discharge, the electro-motive force falling considerably. The Weymersch battery, according to some tests published in the London *Electrical Review*, has an almost constant electro-motive force for a heavy discharge extending over a considerable period. For instance: from cells with two zinc plates 6½ by 6⅝ inches, and one carbon plate of the same dimensions, a current of over ten ampères (about 10.3) was taken for thirty-one hours, and at the end of that time the electro-motive force had only fallen a few per cent. The consumption of zinc was only ten per cent more than the theoretical amount, showing that the local action was slight. The inventor proposes to use the battery for the lighting of country houses on a small scale, for torpedo-work, miners' lamps, etc., besides the ordinary uses to which closed-circuit batteries are now put. He calculates that electric lamps aggregating 45-candle power can be supplied for six hours at a cost of eighteen cents per day. Whatever uses it may be put to, it is certain that the tests make an excellent showing.

The other cell, an invention of Mr. O'Keenan of Paris, has been lately described before the New York Electrical Society by Mr. Alfred Shedlock. It is a simple Daniell element, — zinc and copper electrodes in contact with sulphate of zinc and copper respectively. The invention consists in the means employed to keep the strength of the two solutions constant, and a set of cells is arranged to continuously charge storage-batteries from which lamps are supplied. As the electro-motive force of a Daniell cell is about one volt, while that of the Weymersch cell is two volts, twice as much zinc will be consumed in the former as in the latter for the same amount of energy obtained. Mr. Shedlock states that the cost of the zinc and copper sulphate will be at the rate of about one cent per hour for a 12-candle power lamp. If we add the cost of breakage of lamps, interest on investment, depreciation, etc., it will be found that the total cost is at least double this, and lighting in this way would be expensive.

These two batteries are fair types of the improvements that have been recently made in primary cells. Both of them have a field for usefulness, but neither of them can be economically used for lighting or for heavy motor-work.

INCANDESCENT-LAMP EXPERIMENTS. — The following abstract is from the London *Electrician*: "At a recent meeting of the Société Française de Physique, M. Mascart described some interesting experiments which he had carried out with a view of determining how far incandescent lamps might be a source of danger when in the immediate vicinity of inflammable materials. Some 32-candle power incandescent lamps were tightly enveloped in cloth, others in wadding with the gummed surface removed, and others again were placed in the folds of some old stage-scenery. In no case was there any charring or undue heating. An extra thick cotton hood placed over a 32-candle power lamp became charred wherever it was in contact with the globe after ten minutes had elapsed. A 32-candle power lamp which was surrounded by a black silk hood, and then by a black velvet one, set the latter burning gradually in six minutes. In another experiment two lamps were enveloped respectively in black and white wadding from which the gummed surface had *not* been removed; and in two minutes charring commenced, both lamps burst, and the wrappings were set alight. Finally a 300-candle power lamp was laid against some old scenery: in a minute and a half the scenery began to char where the globe touched it, and slowly burnt without flame."

ELECTRICAL RESISTANCE OF COPPER AT LOW TEMPERATURES. — The following note is from *Engineering*: "M. Wroblewski has undertaken to test the truth of Clausius' remark in 1856, that the electrical resistance of chemically pure metals should be

proportional to their absolute temperature; that is to say, if the temperature of a metal could be reduced to absolute zero, its resistance would be annihilated, and its conductivity increase to infinity. M. Wroblewski took advantage of one of the new methods of producing intense cold; namely, that by means of boiling nitrogen at the temperature of its solidification. Wires of copper about $\frac{4}{100}$ of a millimetre in diameter, covered with a double layer of silk, were taken, their conductivity being guaranteed by the makers at ninety-eight per cent of that of pure copper. With this wire M. Wroblewski wound small bobbins having a resistance at ordinary temperatures of about 3 and 20 Siemens units. As the bobbin had to be plunged in liquefied gas, M. Wroblewski began his investigation by studying the electric properties of liquid oxygen and nitrogen. He found that these substances ought to be ranked among the most perfect insulators. The resistances of the bobbins were then measured by the Wheatstone-Kirchhoff method at the temperature of boiling water, ordinary temperature, the temperature of melting ice, the temperature of boiling ethylene at atmospheric pressure (—103°C.), the critical temperature of nitrogen (—146°C.), the temperature of boiling nitrogen under atmospheric pressure (—193° C.), and a temperature nearly that of the solidification of nitrogen (—200°C. to —202°C.). The results are embodied in the following table, where t is the temperature, r the resistance in Siemens units, and a the co-efficient of variation of resistance between two consecutive temperatures: —

Bobbin I.			Bobbin II.		
t	r	a	t	r	a
+100°C.	5.174	—	+23.75°C.	19.251	0.004057
+21.4	3.934	0.004365	0	17.559	0.004263
0	3.614	0.004136	—103	9.848	0.004104
—103	2.073	0.00414	—146	6.749	0.004869
—146	1.360	0.004588	—193	2.731	0.007688
—193	0.580	0.004592	—201	1.651	—
—200	0.414	0.006562	—	—	—

These numbers seem to show that the resistance decreases much more quickly than the absolute temperature of the specimens, and approaches *nil* at a temperature not very far from that obtained by evaporating liquid nitrogen in a vacuum.

UNDERGROUND ELECTRIC-LIGHT WIRES. — Several deaths caused by shocks from electric-light wires have called attention to the dangers of the present systems of high-potential distribution, and much has been written in the daily journals about the deadly electric-light wires. The general remedy proposed is to put the wires underground, and in many cities ordinances have been passed directing that all wires shall be buried within a certain time. In the present state of things it will be impossible to obey these ordinances. There are great difficulties and expenses incident to any general system of underground distribution in our large cities. The enormous number of telephone and telegraph lines that must be put in conduits with the electric-light wires — for the scheme embraces the burying of all wires — introduces the factor of disturbance of messages from induction as well as the great difficulty of preventing leakage between the different lines, and from the lines to the ground. And in New York, where this work is being done on a large scale, the commission which directs it is composed of politicians who have no idea of the mechanical and electrical difficulties that must be met and overcome. Again: it is very much a question whether the putting of arc-light wires under ground will decrease the danger. The wires have still to be taken to the lamps, and in the branch wires there is the same possibility of accident as before. As the case now stands, then, the putting of electric wires under ground will be attended with trouble and expense, possibly with failure. It will not greatly decrease the danger of high-potential lighting, and it will greatly retard its development. At the same time an efficient underground system is much to be desired. It would be as foolish to give up all attempts in this direction as to try to accomplish it at once, without the necessary experience. The best way would seem to be a gradual putting of the wires under ground, instead of a city directing all the wires to be placed under ground by a certain time. Let them order a certain per cent each year, the localities to be determined by people who know something about the subject. In this way experience will be gained in the cheapest manner, and, if it is found practicable, the end will finally be reached without injury to the companies concerned.

NOTES AND NEWS.

THE *Athenæum* of June 30 announces the death at Brighton of Mr. Edmund Gurney. Mr. Gurney had been subject to obstinate sleeplessness, and had had recourse to opiates. It was an overdose of chloroform that led to his accidental death. Mr. Gurney's best known work was his 'Power of Sound,' a very excellent treatise, and one of permanent value. Of late years he has been oftenest before the public by his contributions to the Proceedings of the Psychic Research Society, of which he was the honorary secretary. He was the chief author of the 'Phantasms of the Living,' and the man to whom, more than to any one else, is due the great interest in psychic studies which this society has aroused. Mr. Gurney had committed himself to the telepathic hypothesis, and was busy to the last in developing that theory. However much one may differ from him in his views regarding the problems of psychic research, all must acknowledge to a great admiration for the courage and industry of the scientist venturing boldly into this psychic 'heart of Africa,' and reporting patiently and systematically his adventures in that mysterious region. His loss is a very serious one to the cause to which he had devoted so many years of his life.

— A. C. McClurg & Co. have just issued the first two volumes of the proposed series of The Great French Writers. The publication of this series has been delayed by the fact that the publishers were disappointed with the translations brought out in England, and therefore undertook the expense of entirely new translations. —— A careful and very valuable bibliography of the works of Sir Isaac Newton, with a list of books illustrating his life and works, by G. J. Gray, has just been issued by Messrs. Macmillan and Bowes, Cambridge. The bibliography is divided into ten sections: (1) collected editions of works; (2) the 'Principia;' (3) 'Optics;' (4) 'Fluxions;' (5) 'Arithmetica Universalis;' (6) minor works; (7) theological and miscellaneous works; (8) works edited by Newton; (9) memoirs, etc.; (10) index. —— A new edition of the late Professor Humpidge's translation of Dr. Hermann Kolbe's 'Short Text-Book of Inorganic Chemistry' (Longman's) has been issued. The greater part of this edition was prepared by Dr. Humpidge last summer. Being unable, owing to failing health, to complete the task of revision, he asked Prof. D. E. Jones of the University College, Aberystwith, to undertake it, and to see the book through the press. —— Mr. Leland will shortly send to the printer his work on 'Americanisms,' which will follow on the 'Dictionary of Slang, Jargon, and Cant,' now in the press. It will contain much folk-lore in the form of proverbs, songs, and popular phrases, and also the etymology and history of the words, as far as they could be traced. The work will include an account of American dialects, such as Pennsylvanian Dutch, Chinook, Creole, and Gumbo. —— Nearly the whole edition of Mr. George Seilhamer's 'History of the American Theatre: Before the Revolution,' has been placed; a second volume, 'During the Revolution and After,' is in press, and will be ready in the autumn. Both volumes are published through the Globe Printing-House, Philadelphia. —— Kegan Paul, Trench, & Co. have made arrangements for the publication of a set of half-crown books to be entitled 'English Actors: Ten Biographies.' The series will be under the general editorship of Mr. William Archer, and will include lives of Betterton, Cibber, Macklin, Garrick, the Dibdins, the Kembles, Elliston, the Keans, the Matthews, and Macready. Mr. Joseph Knight will deal with Garrick, Mr. R. W. Lowe with Betterton, Mr. E. R. Dibdin with the author of 'Tom Bowling,' and the editor himself with the Keans. The subjects have been selected so as to cover as completely as possible the whole field of English acting from the Restoration to our own time. —— Mr. W. J. Linton, one of the leading authorities on wood-engravings of the day, has issued a prospectus, with specimen

pages, of his great work now in press in London, entitled 'Masters of Wood-Engraving.' Ticknor & Co. have been chosen to receive subscriptions for this great work in this country. —— William Gibson, jun., New York, has just issued 'Some Details of Water-Works Construction,' by William R. Billings. ——The Truth Seeker Company has just published 'The Order of Creation, the Conflict between Genesis and Geology, a Controversy between the Hon. W. E. Gladstone, Prof. Max Müller, Prof. T. H. Huxley, M. Réville, and Mrs. E. Lynn Linton;' 'Rome or Reason, a Memoir of Christian and Extra-Christian Experience,' by Nathaniel Ramsay Waters; 'The Bible of Nature, or, The Principles of Secularism,' by Felix L. Oswald; 'Try-Square, or, The Church of Practical Religion,' by Reporter; and new editions of 'The Secret of the East, or, The Origin of the Christian Religion, and the Significance of its Rise and Decline,' by Oswald, and of Winwood Reade's 'The Martyrdom of Man.'—— *Scribner's Magazine* for August will contain another of Prof. N. S. Shaler's notable articles on the surface of the earth, entitled 'Rivers and Valleys,' fully illustrated with views of some of the most picturesque scenery in this country, and dealing in a very practical way with the problems presented by the Mississippi and Ohio River floods.

— A philosophical society has been formed at the University of Vienna under the leadership of Professor Zimmermann and Professor Meynert. Professor Höffler has been elected president. The object of the society is to bring before specialists of all classes general scientific problems having a philosophical import.

— At a recent meeting of the French Physical Society Sir William Thomson was present, and stated, that, according to his determinations, the rate of diffusion of electricity was a hundred and ten times as rapid as that of heat in the best conductors.

— The night movements of the Russian troops have recently been rendered difficult by the number of soldiers attacked with hemeralopia (night-blindness). It is well known that this affection is due generally to a lack of proper food. Meissner saw in Podolia an epidemic of this disease produced during a religious excitement, when bread was the principal article of diet, which disappeared when animal food was again taken.

— The date of meeting of the American Society of Microscopists at Columbus, O., has been changed to Aug. 21 instead of Aug. 14; this on account of change of date for the American Association meeting.

— At the last meeting of the New York Microscopical Society, Mr. George F. Kunz exhibited sand containing monazite, a phosphate of cerium, lanthanum, and didynium, and from 0 per cent to 17 per cent of thoria, from Brindletown, Burke County, N.C., and monazite sand from Caravalhas, Brazil, stating that the demand for these minerals had greatly increased of late, owing to the rare earths zirconia, thoria, glucina, etc., which they contain, and which are now used for the mantle or hood of the new incandescent gas-burner invented by Dr. Carl Auer, now 'Von Welsbach.' This increased consumption has led to a search by the collectors and dealers in minerals in England, Germany, France, Russia, Norway, and Brazil, and more especially in the United States; and so thorough has the search been, that the prices of minerals which were considered rare a short time ago, are now quoted at one-tenth to one-hundredth of former figures. The minerals containing these rare earths are lanthanite, sipylite, tysonite, uranothorite, orangite, thorite, clevite, monazite, beryl, yttrotantalite, alvite, erdmannite, cerite, xenotime, fergusonite, æschynite, allanite, zircon, eudialyte, euxenite, samarskite, gadolinite, and bodenite. Of these, beryl, cerite, monazite, allanite, and zircon have been obtained in large quantities. Sipylite, orangite, and thorite are especially sought for. Monazite has been found at the following localities: Villeneuve, Ottawa County, Canada (a crystal of fourteen pounds and a half); Alexander County, N.C., at Milholland's Mill; Amelia County, Va. (in twenty-pound lump); Norwich, Conn.; Ural Mountains; Mount Sorel (var. turnerite), Tavetch (var. turnerite), and Binnenthal, Switzerland; River Sanarka, Southern Ural; Arendal, Norway. At these localities the occurrence is of mineralogical interest only. At the North Carolina, Georgia, and Brazilian localities it can be obtained in quantity for commercial use. In the North Carolina gold gravels of Rutherford, Polk, Burke, McDowell, and Mecklenburg Counties, monazite is found in considerable quantities in small brown or greenish or yellowish brown monoclinic crystals associated with chromite, garnet, zircon, anatase, corundum, menaccanite, xenotime, fergusonite, epidote, columbite, samarskite, and other minerals. With these associations have been found several of the North Carolina diamonds; and at the Glade Mine, Georgia, diamonds have been found with the monazite, which exists in some abundance also. These localities will furnish tons of monazite within the next twelve months. The Brazilian monazite is found at Caravalhas, Bahia, where its existence was made known about eight years ago by Dr. Orville A. Derby, geologist of Brazil. It occurs in large quantities as a beach-sand, almost free from other minerals, as if concentrated. As it occurs on the coast, it can easily be shipped to any point where it is wanted, and a number of tons have been sent to the United States. The best North Carolina zircon locality is on the old Meredith Freeman estate, Green River, Henderson County, N.C., which was leased for twenty-five years in the hands of Gen. T. L. Clingman of that State, who, as early as 1869, mined one thousand pounds of it, and during that whole period never lost faith in the incandescent properties of zirconia; but when the time of its adoption actually came, through some legal difficulties the general had forfeited his leases, and hence failed to reap his reward. In Henderson County, N.C., and in Anderson County, S.C., zircon is found in large quantities loose in the soil, as the result of the decomposition of a felspathic rock. The crystals are generally remarkable for their perfection, being distinctive of each locality, weighing occasionally several ounces. The recent demand has also brought to light the existence of enormous quantities of zircon in the Ural Mountains and in Norway. Although in Canada, in Renfrew and adjoining counties, enormous crystals have been found up to fifteen pounds each, yet they are so isolated, that it would be impossible to obtain a supply there. The new demand has brought together more than twenty-five tons of zircon, ten tons of monazite, six tons of cerite, thousands of pounds of samarskite, and tons of allanite and other minerals. As a consequence, zircon is now offered at less than ten cents a pound, monazite at twenty-five cents, and samarskite at fifty cents.

— While Australia is complaining of rabbits, Russia is invaded by the marmots. In certain provinces in Odessa it has been proposed to try Pasteur's system of inoculating them with chicken-cholera, but the administrative authorities have not given the scheme their approval.

LETTERS TO THE EDITOR.

Negro Dialect.

A WRITER in the *North American Review* for June, 1888, mentions certain words in use among the negroes of the Southern States, and inquires after their origin. The words are *buccra* ('white man'), *goober* ('peanut'), *brottus* (used in Georgia in requests for small presents, as, 'What are you going to give for *brottus?*'), and *lagniappe* (used in New Orleans in somewhat the same sense as *brottus*).

With regard to *lagniappe*, there seems to be no good cause to dispute the derivation from the Spanish given by Mr. George W. Cable. He says, " The pleasant institution of *ñapa*, the petty gratuity added by the retailer to any thing bought, grew the pleasanter, drawn out into the Gallicized *lagnappe*" (*The Creoles of Louisiana*, London, 1885, p. 114). The derivation of *brottus* may be similar to that of *lagniappe*, from the English perhaps, but one cannot speak with certainty.

The word *goober* ('peanut') is, I think, of African origin. In Haussa (a West African tongue), *guja* is 'ground-nut.' The following passage, however, from a rare and interesting work of the beginning of the eighteenth century, goes far, I hope, to settle the matter.

In the English translation of Bosman's account of Guinea we read, " Here is also another sort called *Gobbe-Gobbes*, which grow

two together in a Cod under the Earth, and shoot out a small Leaf above the surface of the Earth; these are the worst of all the sorts of Beans, and yet they are eaten by several" (*A New and Accurate Description of the Coast of Guinea, etc. . . . Written originally in Dutch by Wm. Bosman. . . . And now faithfully done into English*, London, 1705, p. 301). From *gobbe* to *goober* is not far, and the object named is the same, beyond a doubt. The origin of *buccra* ('white man') is not clear; but in Haussa, *buttra* means 'master.' I would appeal to those acquainted with the negro dialects to publish short lists of words, such as those dealt with, which will be of great value in determining the ethnological relations of the ancestors of the present negro population of the United States.

A. F. CHAMBERLAIN.

Toronto, July 2.

Object-Lessons in Oriental Faiths and Myths.

A REMARKABLE collection will soon be opened to the world in Paris. The municipality has given a plot of ground that cost two hundred thousand dollars on the Avenue d'Jéna, and a large and beautiful stone structure has been erected on it by the state, under a law passed while the present president, Carnot, was finance minister. This law secures over three hundred thousand dollars for the erection of a building, and endows the establishment thus formed with a perpetual annuity of nine thousand dollars for purposes of maintenance. The glass cases for the collection are partly placed and filled, and the public will be admitted in a few months.

The collection is primarily intended to teach the history of the development, and the characteristics, of the Oriental religions. The importance of this study strikes us forcibly when we reflect that these forms of faith still deeply influence the daily lives of more than one-half of the human race, and that they have solaced and guided tens of thousands of millions of our fellow-creatures.

The originator and collector of this unique series of objects is the well-known student of Oriental languages, M. Etienne Emile Guimet, the son of a wealthy citizen of Lyons. He has spent more than twenty years of an active scholarly life in voyages to, and residences in, China, Japan, and other Asiatic lands, and has devoted several millions of francs from his large fortune to this work of public instruction. In his native town he is also known for his persistent and munificent efforts to secure high-class musical entertainments for the people; and, if his efforts are measured by the exquisite congregational singing that I recently heard in one of the Lyons churches, his efforts have been signally successful.

Yesterday I spent the morning with M. Guimet, examining the collections already in place. We first passed through two long halls, carefully arranged, and lighted from both sides with high windows, — halls, let me say, that would form admirable models for the future architects of the Metropolitan Museum. Here we found two comprehensive collections of pottery, — one from China and one from Japan, — each arranged geographically and historically, beginning, in the case of Japan, with the southern provinces, and ending with the northern. These most valuable gifts of M. Guimet, however, do not belong to my present subject.

From these halls we entered the lofty library, where are already placed twelve thousand volumes of books and manuscripts containing official statements in the original tongues of the dogmas, creeds, and myths of all the important Oriental forms of belief. Thence we passed to an extensive hall, in which the Japanese religions are illustrated and classed.

Illustrations of the earliest form of the Shinto nature-worship begin the extensive series. First we have the round metal mirrors resting upon mimic waves of sculptured wood, that stood high in the temple to catch the earliest rays of the rising sun; then figures of the simply clad priests; then the implements for making the primitive offering of fire and incense to the unembodied god. In order of time follow the paraphernalia of the Buddhist priests, who, crossing from Corea, brought with them their gorgeous ritual and imposed it upon the nation. Then we have innumerable figures of Buddha and attendant deities in gold, silver, bronze, lacquer, and clay, representing the ideas of the important contending sects into which Buddhism was soon divided through the agency of sacerdotal ingenuity.

In the middle of the hall, under the skylight, is a representation of the interior of a Japanese temple of the first class, with original images of all the gods before whom worship is usually conducted. Here we may see, how, in the imagination of the Japanese (the sacred Buddha sends forth four great agencies that save men through persuasion), they are shown to the popular eye in the form of golden figures of prophets in silken robes; and also how four other emanations from Buddha, symbolical of darkness, compel men to do right through fear, shown as carved images of black devils with gnashing teeth.

Beyond this group are series of cases containing thousands of objects explaining Japanese myths, lives of saints, and the stories told about their sacred people and places. Another extensive hall contains a series of figures and other objects elucidating the forms of belief, the myths, and the folk-lore of China. In another the Greek mythology is systematized, in another the Roman, in another the Egyptian. One of the most interesting cases is that containing original images from many places in the countries and islands bordered by the Mediterranean, showing the various steps by which the Egyptian gods were accepted and adopted under new names successively by the Greeks and by the Romans. The rooms containing the collections from the western lands are as yet but partly arranged. Enough can be seen, however, to show how important and complete the series of objects must be, — enough to show that the world furnishes no other collection of the kind nearly so large, or so well prepared for the serious study of the development of Oriental and ancient civilization.

M. Guimet declared that he had no theory to support in forming his museum. He has excluded the Christian and the Hebrew forms of worship from his scientific treatment, and has confined himself to those lands where religion dawned upon mankind, and where great faiths that dominated extensive territories were developed. He simply presented the authentic documents and the authorized symbols for the use of the scholar.

L.

Paris, June 20.

An Army of Myriopods.

I am in receipt of a letter, bearing the date July 6, 1888, from Mr. W. H. Cleaver, East Bethlehem, Penn., in which he states that the 'worms,' specimens of which he sends, are at the present time very abundant in his neighborhood.

To quote from the letter, "they are travelling eastward in countless millions. They travel at night or in the cool of the morning and evening. They camp during the day by getting under sods, boards, stones, or any thing to protect them from the heat of the sun. In some places during the day they are piled up in great numbers. They do not seem to destroy any thing on their journey, but go harmlessly along. Fowls will not eat them, and birds do not appear to molest them."

The specimens which accompany the letter are, I think, the common *Polydesmus erythropygus*. In the absence of any complete systematic work on the *Myriopoda*, I am not able to identify the species with absolute certainty. The species is very common in this vicinity, but I have never before heard of its occurrence in such numbers as reported by Mr. Cleaver.

EDWIN LINTON.

Washington and Jefferson College, Washington, Penn., July 7.

The Old South Work.

YOU credit me, in your last number, with instituting the lectures in Chicago, like our 'Old South' lectures here in Boston. That credit does not belong to me. I have for some years been concerned in the direction of the 'Old South Work' in Boston, which is so liberally sustained by Mrs. Hemenway; and recently I gave the opening lecture in the Chicago course. But the credit of instituting the work in Chicago belongs to Mr. H. H. Belfield, the principal of the Manual-Training School in that city. He has labored with rare devotion and energy to establish these 'Old South' lectures in Chicago, and his success has certainly been very great. If every city had a man of equal patriotism and equal practical power, we should see much done to bring our young people up to higher ideas of citizenship, and to elevate the general political tone throughout the country.

EDWIN D. MEAD.

Boston, July 9.

Publications received at Editor's Office, June 11–July 7.

BELL, A. M. Hand-Book of World-English. New York, N. D. C. Hodges. 36 p. 12°. 25 cents. (London, Trübner.)

——World-English: the Universal Language. New York, N. D. C. Hodges. 29 p. 8°. 25 cents. (London, Trübner.)

BELLAMY, E. Looking Backward, 2000-1887. Boston. Ticknor. 470 p. 16°. 50 cents.

BILLINGS, W. R. Some Details of Water-Works Construction. New York, Eng. and Build. Record. 96 p. 8°.

BOLTON, H. C. A Bibliography of Chemistry for the Year 1887. Washington. Smithson. Inst. 13 p. 8°.

CANADA Geological and Natural History Survey, Annual Report of, 1886. Vol. II. Montreal, Dawson Bros. 8°. $2.

ERDE, Die. Lief. 26-30. Liepzig, Hartleben. f°.

FELLOWS, G. S. "Loisette" Exposed; together with Loisette's Complete System of Physiological Memory. New York, Fellows & Co. 224 p. 12°. 25 cents.

GUERNE, J. de. Excursions Zoologiques dans les Iles de Fayal et de San Miguel. Paris, Gauthier-Villars. 110 p. 8°.

HAYMOND, C., Argument of, before Senate Committee, March 17, 1888, on Pacific Railroads. Washington, Judd & Detweiler, Pr. 181 p. 8°.

HILL, D. J. The Social Influence of Christianity. (The Newton Lectures for 1887.) Boston, Silver, Burdett, & Co. 231 p. 12°. $1.25.

HISTORICAL American, The: An Illustrated Monthly Magazine of History, Literature, Science, and Art. Vol. I. No. 1. July. Cleveland, O., 90 Euclid Ave. 80 p. 8°. $3 per year.

MUELLER, F. M. Three Introductory Lectures on The Science of Thought. Chicago, Open Court Publ. Co. 123 p. 12°.

STEELE, J. D. A Popular Chemistry. New York and Chicago, Barnes. 327 p. 12°. $1.25

—— and JENKS, J. W. P. A Popular Zoölogy. New York and Chicago, Barnes. 319 p. 12°. $1.40.

Positions Vacant.

Inquiries from employers in want of those skilled in any department of science in its widest sense will be inserted in this column WITHOUT CHARGE.

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SCIENCE

FRIDAY, JULY 20, 1888.

WHEN THE SYSTEMATIC STUDY of Indian pictographs was begun by the Bureau of Ethnology years ago, it was supposed by those who collected the material that the carvings on rocks and wood, on barks and skins, when they were interpreted, would tell something of the history of the people who made them, as the hieroglyphics of the East have enabled modern scholars to construct the history of ancient dynasties and empires. This expectation has been disappointed. The Indian pictographs are either mythological, or, if they relate to events, it is to incidents in the lives of individuals who are not identified, such as his hunts, the number of scalps he took in battle, etc., or to such events in the history of the tribes as the great religious festivals. They throw no direct light upon the origin, age, or migrations of the tribes that made the pictographs. Indirectly, by the comparative study of the characters made by different tribes, the relations of those tribes may be determined. It is by this comparative study that the Indian pictographs are likely to prove most valuable to science.

THERE HAVE OCCASIONALLY been assembled, at intervals of from five to seven years, international congresses for the discussion of questions relating to crime and penal discipline. At those hitherto held, as at Frankfort, Brussels, London, Stockholm, and Rome, there has been a union of both official and non-official members, with similar privileges of voting on the questions at issue. The next congress is appointed to be held some years hence, at St. Petersburg. It would appear as if the spirit of Russian despotism had taken alarm at the proposal, although unwilling to prohibit such a meeting. But certain influences have been brought to bear upon the committee of arrangement, who have intimated a desire to restrict future decisions on the various questions to official delegates or State functionaries. These, in Russia and some other continental countries, are obsequious servants of the bureaucracy. Hence, if this intention is carried out, the congress may in such hands tend to become a mere clique, or the creature of conditional patronage of northern military despotism, and, as such, rather likely to meet with ridicule than respect from the free public opinion and intelligence of western Europe and America. The French Prison Society, Paris, has already issued a timely protest against this project. That society consists of some of the ablest and most intelligent members of the legislature and scientific bodies of France, and is highly respected at home and abroad. Its objections to the proposed change in the constitution of these congresses will doubtless obtain acceptance in Great Britain and America, and in free nations generally. If, in defiance of such opinion, the St. Petersburg congress is to be manipulated as proposed, its proceedings will be entitled to comparatively little consideration.

THE BILL TO PROVIDE for the eleventh and subsequent censuses has been passed by the House of Representatives, and will no doubt be adopted by the Senate before the adjournment of the present session. The salient features of the bill are similar to those of that which provided for taking the tenth census, except that the number of subjects of investigation are reduced to seven. These are population and social statistics relating thereto, manufactures, mining, agriculture, mortality and vital statistics, valuation, and public indebtedness. The statistics on other subjects included in the tenth census, and which swelled its publications to twenty-two large quarto volumes, although very useful for general information, political discussion, and social science, are omitted because the same information may be gathered by and published from other bureaus of the government more satisfactorily and more economically. They are of continuing importance, and are not limited to the precise period when the census is taken. The number of volumes to be printed will probably be reduced to seven, and their publication will not be delayed as formerly.

THERE WILL BE HELD next year, during the Universal Exhibition in Paris, a large number of scientific congresses, — of zoölogy, anthropology, physiology, electricity, dermatology, and hygiene, — besides the literary congresses and those devoted to economics and the arts. The exhibition will draw to Paris a large number of strangers, and will therefore be a favorable occasion for these international re-unions. It is to be hoped that the scientific congresses of 1889 will be as satisfactory in their results as those previously held. As an admirable model, we would call attention to the International Electrical Congress of 1881. This congress decided upon a reform in electrical measures. Up to that time, each experimenter had employed that system of measures which best served his purpose. Thanks to the electrical congress, these variations are now at an end. In order that the congresses of 1889 may accomplish all that may be expected of them, it is desirable that programmes should be arranged well beforehand, and the scientific world will look to the organizers of the congresses for this needed guidance. In large part the proper organization of the congresses will depend upon the local scientific societies of Paris.

THE LARGE AMOUNT of light sandy soils in some of the northern counties of Michigan which do not appear to respond favorably to ordinary methods of tillage, seems to call for investigation and experimental inquiry. Some persons doubt the possibility of their successful cultivation, and are disposed to scoff at all attempts in that direction. The fact that many persons have settled on these lands for homesteads, and after a few years have abandoned their claims and gone elsewhere for permanent homes, seems to countenance the doubt about their agricultural value. The hundreds of abandoned homesteads give sad evidence of misdirected labor and disappointed hopes. The question is, how to bring these lands into profitable cultivation by such methods of tillage and the use of such manurial materials as are within the reach of every farmer of moderate means. It does not include the use of stable-manure, for the reason that this cannot at present be obtained in sufficient quantity to supply the needs of the plains. No one need doubt the capacity of these sandy soils to produce crops if a sufficient supply of stable-manure can be obtained. The first question is, how to raise the crops on these lands that shall furnish the stable-manure. The problem briefly stated is this: with a light sandy soil of very porous quality, in a northern climate, subject to late frosts in spring and early frosts in autumn, and liable to midsummer drought, with no fertilizers except marl, salt, and plaster, can any methods of tillage or kinds of crops bring these plains into profitable cultivation for ordinary farming, stock-raising, or fruit-production? For many years Prof. R. C. Kedzie of the Agricultural College of Michigan has given thought and study to this problem, and in lectures and articles called attention to the subject. When the Hatch Bill became a law, it was felt that the time had come to take up this sub-

ject in a practical way. A farmers' institute had been held at Grayling, Crawford County, in which farming on the plains occupied most of the time and thought of those present. When it was determined to establish an experimental farm on the plains, the State Board of Agriculture fixed upon Grayling as the place, because it is in the heart of the jack-pine lands, is readily accessible by railway, is near a large deposit of marl, the people take a lively interest in the experimental work, and the Michigan Central Railroad offered to donate eighty acres of jack-pine land for the experimental farm. The tract of land donated, both as to soil and the natural products growing on it, is considered a fair average of the jack-pine plains. The experimental work at Grayling is only begun, and it is too soon to ask, "What shall the harvest be?"

THE STORRS SCHOOL Agricultural Experiment Station, Mansfield, Conn., has issued its first bulletin. The purpose of this bulletin is to explain to the public whom the station is especially intended to serve, the organization of the station, its spirit, and the character of the work thus far begun. It is the wish of those in charge of the enterprise to make its connection with the farmers of the State as intimate as possible, and to this end copies are mailed to all farmers in Connecticut whose addresses the station has been able to obtain, to a number of other persons within and outside of the State, as well as to the press. By the act of Congress, provision is made for the appropriation of fifteen thousand dollars per annum to each State and Territory, for the maintenance of agricultural experiment stations. Of the fund for Connecticut, one half is, by act of its last Legislature, intrusted to the Board of Control of the State Experiment Station, and one half to the Board of Trustees of the Storrs Agricultural School. The managers of the station recognize that its purpose is both to investigate and to teach, that its duty is to select for study such questions as are of the most immediate and practical importance to the agriculture of the State, and that its work will be successful in proportion to the intimacy of its connection with the farmers whom it represents. But they feel bound to accept the lesson taught by years of experience, in this country and elsewhere, to which we have already frequently referred, that the most valuable results will be obtained by selecting a small number of questions for investigation, by making them narrow and specific, and by studying them with the greatest possible thoroughness. And they desire to avoid, so far as may be, the error into which so many stations, in their early experience, have fallen, in failing to recognize that often the questions which seem most theoretical are really most practical; that the highest, and in the long-run the most useful, work for agriculture is the discovery of the laws that underlie its practice; and that not infrequently the interests of the farmer require that theoretical questions be considered first, for the same reason that the foundation of the house is the first part to be built. In using part of its resources for abstract research, the managers of the station feel assured that it is doing its highest duty, and will have the heartiest support of its constituency.

INTELLIGENT CITIZENSHIP.

WE had occasion recently to refer to the growth of the Old South Work. This work has been carried on in various ways, — by lectures, by tracts, and by encouraging the writing of essays on appropriate subjects.

The 'Old South Leaflets,' which have been published during the last five years in connection with the annual courses of historical lectures at the Old South Meeting-House in Boston, have attracted so much attention, and proved of so much service, that the directors have determined upon the publication of this general series, with the needs of schools, colleges, private clubs and classes, especially in mind. The leaflets are prepared by Mr. Edwin D. Mead. They are largely reproductions of important original papers, accompanied by useful historical and bibliographical notes. The aim is to bring them within easy reach of everybody. The Old South Work is a work for the education of the people, and especially the education of our young people, in American history and politics; and its promoters believe that few things can contribute better to this end than the wide circulation of such leaflets as those now proposed. It is hoped that professors in our colleges, and teachers everywhere, will welcome them for use in their classes, and that they may meet the needs of the societies of young men and women now happily being organized in so many places for historical and political studies.

Some idea of the character of this series may be gained from the following list of the subjects of the first thirteen numbers, which are now ready: No. 1. 'The Constitution of the United States;' 2. 'The Articles of Confederation;' 3. 'The Declaration of Independence;' 4. 'Washington's Farewell Address;' 5. 'Magna Charta;' 6. 'Vane's "Healing Question;"' 7. 'Charter of Massachusetts Bay, 1629;' 8. 'Fundamental Orders of Connecticut, 1638;' 9. 'Franklin's Plan of Union, 1754;' 10. 'Washington's Inaugurals;' 11. 'Lincoln's Inaugurals and Emancipation Proclamation;' 12. 'The Federalist, Nos. 1 and 2;' 13. 'The Ordinance of 1787.' A large proportion of these early numbers relate to the Constitution and the history of its growth, which are now subjects of special interest to historical students.

The excellence of the essays which have been presented during the last seven years, in competition for the Old South prizes, have induced the offer of prizes again the present year. The competition for these prizes, which could well be imitated in other towns, is open to all who have graduated from the Boston high schools (including the Latin schools) in 1887 and 1888.

The subjects for the essays are, 'England's Part in the Crusades, and the Influence of the Crusades upon the Development of English Liberty;' and 'The Political Thought of Sir Henry Vane. Consider Vane's Relations to Cromwell and his Influence upon America.'

Forty dollars will be awarded for the best essay on each of the subjects named, and twenty-five dollars for the second best, making, in all, four prizes.

The Old South lectures for young people for the summer of 1888 will begin Wednesday afternoon, Aug. 1. The general title of the course will be 'The Story of the Centuries,' the special subjects being as follows: 'The Great Schools after the Dark Ages;' 'Richard the Lion-Hearted and the Crusades;' 'The World which Dante knew;' 'The Morning-Star of the Reformation;' 'Copernicus and Columbus, or the New Heaven and the New Earth;' 'The Age of Queen Elizabeth;' 'The Puritans and the English Revolution;' 'Lafayette and the Two Revolutions which he saw.'

Many of those interested in the Old South Work are also interested in the Massachusetts Society for promoting Good Citizenship. In response to the question which is often asked, the society has issued a circular telling what is the object of this society, and what its members are expected to do. It is the intention of the promoters of the society that it shall encourage and assist every thing which tends to make men good and intelligent. The good citizen is, as they express it, before all else the good man. As De Tocqueville saw it to be in his time, so we see it to be in ours, the success of a republican-democratic government depends upon the moral and intellectual capacity of the community. We need intelligence, education, conscience, and health, and it is to promote these that the society is working.

The immediate and special inquiry as to the nature of good citizenship leads to the study of political history and political philosophy, and the society wishes to see a more serious and thorough study of what the world's great thinkers in the past have thought and said upon government and the state; and they would encourage a more careful study of our American history and institutions, our constitutions and laws, and this in comparison with those of other countries. The members of the society individually, or in association with each other in clubs or classes, are urged to these studies for themselves, and to promote and assist such studies on the part of others. The society would have its members study the town and the town-meeting, the city, the commonwealth, the nation, and international relations, believing that by such broad studies in the history of pol-

itics a true civic spirit is chiefly sustained, and that they are therefore the primary duties of the American citizen, and especially of those who desire to promote a more intelligent patriotism and a better public opinion.

As it has so often been urged, so does this society urge upon every good citizen his duty to give earnest attention to the political and social questions of the day, — such questions as, at the present time, protection or free trade, prohibition or license the relations of capital and labor, the limits of state control of industries, immigration, and international arbitration. The society urges that it is the good citizen's duty, which we presume no one will deny, to dispel ignorance and to spread knowledge of facts on these subjects, and to foster a large and worthy spirit in dealing with them. They further urge that it is the citizen's office to make knowledge powerful and controlling by attending punctiliously to his own duties as a voter.

The advantages of lyceums, debating-clubs, and lectures as means in developing an intelligent interest in political subjects are urged, and it is believed that members of the society can do much to sustain these. The society proposes further to aid the efforts of the members by publishing all the really useful matter that it can, in tracts, in pamphlets, and in the newspapers, and it has charged a competent committee with the preparation and recommendation of courses in reading and study. Another committee will give advice and assistance in procuring good lecturers. The larger the membership of this society, the wider will be its field of operation, and it is naturally desirable that there should be as many as possible who will give careful attention to the matter of local organization.

SCIENTIFIC NEWS IN WASHINGTON.

Stocking the Pacific Ocean with Lobsters; the First Successful Experiment in transporting Them Alive across the Continent; the Difficulties of Artificial Lobster-Propagation; Only One or Two Mature Lobsters from 12,000 or 15,000 Eggs. — A Curious Iroquois Mythologic Tale. — The Contour of the Atlantic Ocean's Bed; a Beautiful Model sent to Cincinnati by the Hydrographic Office.

Sending Live Lobsters to California.

THE United States Fish Commission shipped from Wood's Holl, June 16, 600 live lobsters and 250,000 lobster-eggs. Of the former, 350 arrived safely in Sacramento, Cal., June 22, and they have been deposited in the Pacific north and south of San Francisco. Several previous attempts to take live lobsters across the continent have failed. Of those sent only as far as Chicago, packed in seaweed in crates, only one in four survives.

Colonel McDonald, fish commissioner, personally superintended the packing of the lobsters lately sent to California. A crate or box devised by the late Captain Chester was used. This was placed within another larger box, the intervening space being filled with pounded ice. In the inner box the lobsters were placed between layers of rockweed, which at times was moistened with seawater. Each box had an independent drain, so that the fresh water from the melting ice could not enter the lobster-box. The temperature of the latter was kept at 45° F. A fish-commission car was used, the boxes along the side of it serving as the outer box of the combination described above; one hundred crates, each containing six lobsters, being placed in them, and surrounded with ice. Each morning before sunrise a careful inspection of the lobsters was made, and those that had died were removed. The first day 45 died; the second day, 55. After that the mortality was much less. All of those that died were in an advanced state of shedding, and were in poor condition when they started.

One-half of the 350 lobsters that arrived safely on the Pacific coast were placed in the ocean north of San Francisco, and the other half south. It is hoped that this experiment may demonstrate the feasibility of stocking the waters of the Pacific on the California coast north of Monterey with this delicious shell-fish. The condition of the water in that region is quite similar to that of the Atlantic off the Massachusetts coast. The temperature is about the same, except that it is more constant. The lobster on the Massachusetts coast crawls out into deep water in the summer, where the temperature is low, but it is thought that the equable temperature of the Pacific will enable the lobster in those waters to spend the whole year in one spot.

Hatching-apparatus was taken to California with the 250,000 lobster-eggs shipped. The young lobsters produced by these eggs will be deposited in the sea at once. Although a fair trial will be made to determine the possibility of stocking the Pacific by artificial propagation, much more confidence of success is expressed by Colonel McDonald from the introduction of mature lobsters. The young lobsters have to be placed in the sea almost as soon as they are hatched, and begin to feed most voraciously, even devouring each other. For a few days they swim on the surface of the water, where they find food suited to their requirements, but where they also encounter millions of enemies. After their walking or crawling organs are developed, they sink to the bottom, which they then make their home. One of the problems which the United States Fish Commission is now attempting to solve is the invention of some method of keeping the little lobsters in confinement and safety after they are hatched, until they have attained sufficient strength and size to enable them to protect themselves. The importance of such an invention will be appreciated when it is known, that, from the 12,000 to 15,000 eggs produced by a female lobster in a year, not more than two lobsters, when left to nature, become full grown. Not only are almost all the little lobsters destroyed by their enemies, but a large proportion of the eggs are devoured by fish and sea-birds before they are hatched. If, after artificially hatching the eggs, the Fish Commission could protect the young lobsters until they are large enough to take care of themselves, the supply of lobsters, which is now hardly equal to the demand, and would not one-half supply it if the price was reduced, might be increased almost indefinitely.

Iroquois Mythology.

The Bureau of Ethnology, in addition to the great variety of other work upon which it has been engaged, has almost from its first organization been collecting the quaint and curious stories prevalent among the Indians, translating and transcribing them, and arranging them for future comparison and study. Most of these stories are mythological; and it is one of the most curious and interesting facts, recently discovered, that the life of certain tribes of Indians is almost exclusively a religious one, far more so than that of the ancient Hebrews in any period of their history, and that the religious element is more intimately interwoven in the daily life of all the tribes than has heretofore been suspected. In the light of this discovery, the legends and mythologic tales that the Bureau of Ethnology has preserved, and to the stock of which almost daily additions are made, become of greater scientific value than ever before.

As an illustration of the character of some of these stories, the following obtained from the Iroquois, entitled 'Hinohoawak and his Grandmother,' is interesting, first, because, although all the characters in it are personified, not one of them is a human being; and, second, because of the picturesque and graphically vivid style in which the story is told. 'Hinohoawak,' translated, means 'the son of thunder.'

"There was a very poor old woman who lived in the woods. She was nothing but skin and bones. She lived in a smoky little house, and she cried all the time, both day and night. Her blanket was so old and dirty that no one could tell of what material it was. She had seven daughters. Six of these were carried off one after another by people. The seventh died.

"The daughter that died had been buried some time, when the old woman heard crying at the grave one night. She took a torch, went out, and found a naked baby. The child had crawled up out of the grave through a hole in the earth. The old woman wrapped the naked baby in her blanket and took it home. She didn't know her daughter was with child when she died. She did not suspect it.

"The infant, a little boy, grew very fast. When he was of good size, she came home one day from gathering wood, and could not find him. That night it stormed, thundered and rained. The child returned to her in the morning. His grandmother asked, 'Where have you been, my grandson?' — 'My grandmother,' said he, 'I have been with my father: he took me home.' — 'Who is your father?' — 'Hino ['Thunder'] is my father. He took me

home first, then we came back, and were all around here last night.' The old woman asked, 'Was my daughter in the grave your mother?'—'Yes,' said the boy, 'and Hino used to come and see my mother.'

"The old woman believed him; and as he grew he used to make a noise like thunder; and whenever Hino came into the neighborhood, he would go out and thunder, and help his father. He was Hinohoawak, son of Hino.

"After some time he asked his grandmother where his six aunts were, and his grandmother answered, 'There is an old woman, and her son Yeq-hdjiho-wa-wak, whose house is far away, and they live by playing dice and betting. Your aunts went one by one with a company of people, played, were beaten, and had their heads cut off. Many men and women have gone to the same place and lost their heads.' Hinohoawak said, 'I will go, too, and kill that woman and her son.' The old woman tried to keep him at home, but he would not stay with her. He told her to make two pairs of moccasons for him. He was very ragged and dirty, and she made the moccasons, and got him the skin of a flying squirrel for a pouch.

"He set off to the west, and soon he came to a great opening where there was a large bark house with a pole in front of it, and on the pole a skin robe. He saw boys playing ball in the opening, and went on a side-path and heard a great noise. By and by the people saw him, and one of them said, 'I don't know where that boy comes from.'

"The old people were betting, and the boys playing ball. Soon an old man came up to Hinohoawak and gave him a club; and he played so well that the old man came again and said, 'We want you to play dice: we will bet with you, all the people.' A bowl was placed on an elk-skin under the pole. The woman and her son were there, and the people were standing around.

"Hinohoawak answered, 'I don't know the game;' but the old man said, 'We will risk our heads on you.' So he followed the old man. He saw a white stone bowl as smooth as glass. The old woman was sitting there on the elk-skin ready to play, and Hinohoawak knelt right down by the bowl. She said, 'You play first.' —'No,' said he, 'you play first.' So she took the dice,—round ones, made out of peach-stones,—blew on them, and threw them into the bowl, which she shook. The dice flew up into the air, and all turned into crows, cawing as they went out of sight. After a while they came down, cawing, and turned back into peach-stones as they touched the bowl. The old woman was to play three times, and must get seventeen. She threw three times, but got nothing.

"Then Hinohoawak, to win, took dice out of his pouch of flying-squirrel skin. The old woman wanted him to use her dice, but he wouldn't touch them. He shook the bowl, and ducks flew up. They went very high, and all the people heard them as they rose. When they touched the bowl they were peach-stones again, and counted ten. Then Hinohoawak shook the bowl again, and called, 'Game! game!' but the old woman called out, 'No game!' Back they came and counted another ten. He tried the third time, and made ten more. He had won.

"Then he called the people to come and see him cut off the heads of the old woman and her son. 'No,' said the old woman, 'you must play again. Here is my son. You must play ball with him; and if he loses, we shall both forfeit our heads.' Then Hinohoawak asked the old man what he thought. The people, seeing how smart he was, said, 'Play;' and he went to the ball-ground ragged and poor-looking. There were but two playing, one on each side. Then Hinohoawak jumped, and knocked the club out of his antagonist's hand. Then Yage-hdji-ho-wak ran for his club, but before he could get it back, Hinohoawak had sent the ball through the barrier. This was repeated seven times, and Hinohoawak won the game. 'Now,' said he to all the people, 'you can have the heads of the old woman and her son.' The two heads were cut off, and the boys played with the old woman's head over the whole field. 'Now,' said Hinohoawak, 'I am going to bring my grandmother to this place, and we must all come here to stay, and have this long house to live in.' All went home to their houses; and as he went, he sang praises of himself, and his grandmother heard him on his way. He told her what he had done, and said, 'We must all go there and live in that nice house and field.' She got provisions ready, and they went. It took them a long time to reach the place. All the others came too, and built houses around in the field. When all the people had settled down, Hinohoawak went out and called them to the council-house to have a dance. After they had finished the dance, all went home.

"The grandmother put away her old blanket, and began to dress. She put on the clothes left by the old woman who lost her head, and soon she looked like a young woman, and they lived happily. After a while, Hinohoawak went off with Hino, his father, and staid all winter with him.

"In the spring the old woman was uneasy in mind. She heard thunder in the west, and pretty soon her grandson came to the house, and she was very glad to see him.

"'Where have you been?' she asked. 'At the great mountain far off in the west. I have been with my father, helping the nations and protecting men.'

"After that he staid at home all summer. Once in a while he would go away when it began to storm, but he came back again when the weather was good. He lived a long time in this way, till at last he said to his grandmother, 'I have an uncle living in the west. Some witch stole him from you. I must go and find him.' And so he went to the west to search for his uncle. He went on till he came to a house in which he saw a woman sitting by a fire, with her head on her hands. She wouldn't answer when he asked where his uncle was. By and by he went out, took the war-club from his pouch, knocked her on the head, and killed her.

"When he had killed the woman, he went out and walked all around the house, mourning, and looking for his uncle. He looked into the trees, but couldn't see any one; he looked upon the ground, but couldn't find him. By and by he came to a large slippery-elm tree, and the great roots held down a man. His head came out between two roots on one side, and his feet between two more on the other. The tree stood right on the middle of his body, and he was calling to his nephew to give him a smoke. And the nephew said, 'Oh, poor uncle! I'll give you a smoke pretty soon.'

"Then he kicked the tree over, saying, 'Rise up, uncle;' and the uncle rose up and was well. Then Hinohoawak took out his pouch and gave the old man a smoke. The uncle was very much pleased and strengthened. Then he told his nephew how the woman had beguiled him to go with her, pretending that she wanted to marry him; and when she had him at her house, she ate him up, and put his bones under the elm-tree. Then both went home to the long house. The old grandmother was surprised and glad. All lived happily there till one day when Hinohoawak went off in a storm. When the storm was over, he brought home a wife.

"When he went off after that with a storm, his wife was uneasy. She didn't know where he was. Hinohoawak had brought her such a long distance home on his back in the storm.

"After a time she had a son; and when the boy was large enough to run about, the old man, Hinohoawak's uncle, whose bones had lain under the elm-tree, began to teach him, and soon he was able to make a noise like thunder. One day the boy followed his mother out of the house. They had a little dog, and, as the boy was running after it, somebody seized him and rushed away; but the dog ran after him, managed to catch hold of his feet, pulled off his moccasons, and carried them home. This was the first indication the woman had that her boy was gone. Hinohoawak was off with a storm at the time, and when he came home his wife asked him if he had taken the boy. 'No,' said he. 'Oh, he is lost!' cried she. 'Oh, no! he is all right,' said Hinohoawak. 'He has many relations around the world, uncles and cousins.'

"The boy staid away all winter.

"When the winter was over, he came home one day with his father. Then Hinohoawak said to the people of his family, 'We must all move away and live with my father.' The old woman said, 'No, we cannot go, it is so far, and I am so old.'—'I'll carry you there in a little while,' said the grandson. Then Hinohoawak began to thunder, and lightning flew around. The house was torn to pieces, and blazed up in flames. All the rocks and houses in the opening were broken to bits. Hinohoawak and all of his people rose up in the air. The east wind began to blow and carry them

to the Rocky Mountains, where they found old Hino. All live there in the caves of the rocks."

Models of the Ocean's Bed.

The Hydrographic Office has sent to the Cincinnati exhibition a collection of charts, photographs, etc., illustrating the work of the office and the modes of doing it. These will be interesting to scientific men, teachers and students, but, except the photographs, are not likely to arrest the attention of the average visitor. But there are two plaster-of-Paris models in the collection that are certain to be examined with curiosity, and studied with profit, by every one who stops to look at them. They are models of the bed of the Atlantic Ocean and of that of the Caribbean Sea. These have been made by Mr. E. E. Court, of the Hydrographic Office, and the charts from which they were constructed have been carefully revised by Commander J. R. Bartlett and Lieut. J. L. Dyer, respectively former and present hydrographer.

Each of these models shows the contour of the bottom of the sea, that of the Atlantic embracing the whole ocean from latitude 60° north to latitude 40° south, or from Greenland in the north to the unknown region in the south, and includes the Mediterranean Sea on the east, and the Caribbean Sea and a part of the Gulf of Mexico on the west. The chart from which the necessary data were plotted in order to make the model was compiled on a very large scale from the charts of the United States and all foreign hydrographic offices, the very latest deep-sea soundings having been utilized. The contour-lines are drawn according to these soundings. This chart, while it tells the whole story to the experienced hydrographer, — the figures with which it is covered possibly conveying to his mind a picture of how the bed of the Atlantic would look if spread out before him so that he could get a bird's-eye view of it, — is entirely meaningless to the great mass of people. But in the model that is constructed from the chart every depression of the ocean is represented by a corresponding depression in the plaster-of-Paris; so that even a child, with a few words of explanation, can obtain from it a clearer, more vivid, and more correct idea of how the bed of the ocean looks than the man of science could obtain from a chart.

The horizontal scale of the chart and model is sixty nautical miles, or one degree of longitude, on the equator, to each six-tenths of an inch; and the vertical scale is fifty times as great as the horizontal.

The original model was made of wooden boards, one-eighth of an inch thick, each layer representing 250 fathoms of actual depth of the sea. The intermediate soundings are also very carefully represented by carvings of the boards. When the entire contour had been fully represented in the wooden model, a plaster-of-Paris cast was made from it, and this was carefully painted so as to represent in their actual colors, as shown by deep-sea soundings, the mud at the bottom of the sea. As the depth increases each thousand fathoms, the shade becomes darker and darker, the darkest being in the deepest place known, — 4,561 fathoms, or about 5.2 statute miles.

There are many things shown by this model that will be surprising to almost everybody except the expert hydrographer. One of these is the great height of many of the small islands from the ocean's bed, when compared with their area either above the surface of the water or where they rest upon the bottom of the sea. Of course, this height is exaggerated in the model by making the perpendicular scale fifty times as great as the horizontal scale; but, even allowing for that, these islands stand up like tall, narrow, truncated cones, many of them not being more than twice as far across at the base as at the top.

The model of the bed of the Caribbean Sea was designed by Commander J. R. Bartlett, and the chart was compiled from deep-sea surveys made by himself and by Lieut.-Commanders W. H. Brownson and Z. L. Tanner. The latest soundings are embodied in it. In this model, of which the horizontal scale is thirty-three miles to an inch and the vertical thirty-three times the horizontal, the topography of the land is given in the same proportion as the depths of the sea.

Duplicates, or even photographs, of these models would be of very great value in the teaching of physical geography. That of the bottom of the Atlantic Ocean would give a pupil more actual instruction in a quarter of an hour than a week's study of descriptive text.

ELECTRICAL SCIENCE.

Continuous and Alternating Currents.

IN the last few months discussions have taken place, both in England and this country, as to the relative value of continuous and alternating currents for the distribution of electrical energy. In England the employment of storage-batteries with the continuous current has been advocated: here the simple direct system has been pitted against the alternating. We have noticed these discussions from time to time: now that they are finished, it will be well to sum up the results.

The alternating system, employing induction-coils or transformers, has the advantage of allowing the current to be distributed at a high potential to the points of consumption, and therefore it requires distributing-wires of comparatively small section. There seems little doubt, as matters now stand, that it is best for scattered towns, or even in cities if the lighting is mainly confined to theatres, clubs, stores, etc., which are at a considerable distance apart, and which are to be supplied from a central station. When it comes to domestic lighting, however, where we wish to supply entire districts in cities with electric lights instead of gas, the case is different. Let us consider the availability of the three systems — alternating, direct, and direct with storage — for this purpose. The practice with the alternating system at present is to have a transformer for each house to which lights are supplied. When a large number of houses are to be supplied in a city district, this plan cannot be economically carried out, especially if the wires are forced under ground. The insulation of such a complicated network of high-potential wires would be difficult and expensive, — almost impracticable, in fact. Again: as each house would have a transformer whose capacity would be the maximum number of lights that would be used, and as the average number of lights is only a small fraction of the maximum, the transformers — which are not economical when their load is small — would have a low average efficiency. If the alternating system is to be introduced into cities to seriously displace gas, it must be on some such plan as Mr. Kapp proposes. Large converters are placed at different points in the district to be lighted, and the current is distributed at low potential from these. It will be found, if this is done, that the saving in wire is not so large as might be expected, for the greatest expense will be in the low-potential distributing-mains.

The only storage-battery system in extended practical use is that employed by Mr. Crompton. A number of sets of cells are distributed in sub-stations through the district to be lighted, the different sets are connected in series, and the lamp-circuits are taken from the terminals of each set of cells. The batteries act then partly as a converter, allowing high-tension currents for distribution, with a comparatively small difference of potential at points of consumption. Another advantage lies in the fact that the cells can be charged when the demand is light, and discharged at the time of maximum demand, thus allowing a smaller generating-plant. Mr. Crompton claims a high efficiency for the arrangement, and he is no doubt right. There is a loss, of course, in the part of the energy stored, but very little in that converted; and, as the former is not a large part of the total output, an efficiency of eighty-five per cent is not improbable. Mr. Crompton also claims that the repairs of the battery will not amount to more than ten per cent of their cost. The disadvantage of this system lies in the fact, that, with batteries in the circuit, insulation is difficult; and while the difference of potential between the leads taken from the two ends of a set of cells is only, say, one hundred volts, yet the difference of potential between these and the ground depends on the position of the set, and might be high. In fact, we have the disadvantage of distributing at a comparatively high absolute potential, with all the difficulty of insulation that it entails.

The simple direct system has the advantages of a high efficiency and simplicity, and it is economical within a limited area of distribution. It has the disadvantages that the station must be located near the centre of the district to be illuminated, and the area of operation is restricted.

When it comes to supplying an entire city with light, and the question of the relative cost of the various systems is considered, it will probably be found that the most economical will be not any one of the systems, but all of them, — two or three stations in the city proper for the direct and storage systems, the latter for localities distant from the central stations. For the suburbs the alternating system could be used, the stations supplying the alternating currents also supplying arc lights.

It should be noticed that in the discussion in England before the Society of Telegraph Engineers and Electricians, Mr. Kapp, who championed the alternating-current side of the question, admitted that a system of distribution by storage-batteries was the ideal system, but he said that he knew of no reliable storage-batteries. Mr. Crompton's system is not a complete storage system: as has been pointed out, he uses the secondary batteries more for converters than for their storage properties. In a complete storage system the batteries should be so arranged that the full capacity of the station is utilized, so that the engines and dynamos are giving their maximum output the whole twenty-four hours. To do this with safety, there should be two sets of cells, one being charged while the other is discharging. There can be no question that storage-batteries have been greatly improved in the last few years, there is no question about the possibility of future improvement: so we may look for developments in this direction.

If the discussions have shown any thing, they have shown that the direct system is the best for crowded centres, the alternating for scattered towns and suburbs, while Mr. Crompton's storage system could be used to at least double the area of economical distribution from a direct-current station.

ELECTRIFICATION OF METAL PLATES BY IRRADIATION WITH ELECTRIC LIGHT. — The influence of light on electric phenomena, which has attracted so much attention in the last year, is being made the subject of numerous researches. Mr. Hallwachs describes some interesting experiments that he has lately carried out. A metal plate was suspended inside of an iron cylinder whose axis was horizontal. The plate was five centimetres in diameter. The cylinder was fifty centimetres long by thirty-seven centimetres in diameter. The surface of the plate was coated with rust except in one spot, where it was brightly polished. It was first connected with the earth. The wire by which it was suspended passed through, but insulated from, an earth-connected brass tube, to an electrometer. In one end of the iron cylinder was a circular aperture eight centimetres in diameter, covered with wire gauze to prevent any inductive influence of the electric lamp used on the plate. The cylinder was electro-negative to the case, so that any transport of electricity by radiation — a phenomenon described by M. Righi — would have charged the plate negatively. If, now, a plate of mica was placed in the aperture in the cylinder, and the plate illuminated by an electric light, there was no indication on the electrometer. If, however, the plate of mica was replaced by a much thicker plate of selenite, the electrometer gave a gradually increasing deflection, indicating positive electricity. This at once ceased when the selenite was replaced by mica. The rise of potential cannot, therefore, be due to an inductive action, nor can it be referred to the action of heat. The metals which were used for the experiments just described were zinc, brass, and aluminium. In all three, positive electricity occurred on irradiation with brightly polished surfaces. Old surfaces no longer showed the phenomenon. The radiation itself lowers the potential to which the plates can be electrified; so that with any succeeding experiment made with the same surface the potential obtained is lower, while the rise to it takes place more rapidly. The maximum potential with zinc amounted to over a volt, with brass to about one volt, and with aluminium to five-tenths of a volt.

ELECTRIC-LIGHTING IN MINES. — For some years past efforts have been made to introduce electric lights in mines, and rewards have been offered in England for the invention of some safe, reliable, and economical system of lighting. The difficulties to be contended with are these: For permanent lights there is trouble in insulating the leads in such a way as to prevent possibility of breaks or grounds, the demand on the insulation being particularly trying, while there is danger that the breaking of the lamps will explode any inflammable gases around them. For miners' lights, the greatest trouble is to get a portable battery that can be easily carried, and which is cheap and simple. In this country no advance has been made in the application of electricity to mine-lighting; but in England much attention has been directed to it, and electric miners' lamps are being extensively introduced. In the National Colliery, Rhondda Valley, no less than eight hundred such lamps are used, while they are being introduced into other mines controlled by the same company. These are on the Swan system. At Cannock Chase the Pitkin system is employed; at Aldwarke, the Sun system. With the excellent primary batteries that have been lately brought out, and with the improvements that have been introduced in miners' lamps, it is probable that they will soon be largely used in mining-work.

BOOK-REVIEWS.

Proceedings of the Society for Psychical Research. Part XII. June, 1888. London, Soc. Psych. Research.

THIS number of the Proceedings deals almost exclusively with a class of facts towards which it is becoming more and more difficult for the man of science to assume a fitting attitude. The men who vouch for the correctness of the facts are in part drawn from their confrères, eminent in other branches of science. They are apparently on their guard against some, at least, of the many and various forms of deception. They, with some exceptions, set forth their results with much candor, and without conscious bias. And yet one reads their writings with the conviction, that grows as one reads, that all this is premature, that these men do not give evidence of that same comprehensiveness and scientific reserve which they would exhibit in case of a problem touching upon their own specialty. One feels the absence of a sound psychologic insight, such as comes only from years of special training, and the experience of a life dominated by a powerful interest for this kind of phenomena. One longs for the counterpart of such a man as Robert-Houdin, training every sense to its maximum of sensitiveness, and every muscle to the utmost expertness, in order to be a master in the art of deception. In the goings-on of his daily life he is constantly on the alert for some chance combination of events that suggest a new mode of misleading the spectators of his conjuring. Again, the length of the articles; the large proportion of theorizing; the lack of constant reference to the results of others, especially of those not in harmony with their own views, — all this, not to mention occasional serious faults in logic and sad deficiencies in the stringency of the observations, will far postpone the day when these Proceedings will be found on the shelves of a strictly scientific library.

The English Society for Psychical Research, it need scarcely be said, has definitely accepted the hypothesis of telepathy, — of the action of mind upon mind apart from the recognized channels of sense. They accept this not merely as the only satisfactory principle by which their facts can be accounted for, but they are ready to use the theory as a means of explaining other groups of facts. All of the four main contributions to the present number deal with facts of telepathy, and largely with the relation of this power to hypnotism. M. Charles Richet takes up one hundred and fifty pages with an account of a very elaborate and extended series of observations of such transferrence. This paper is to be ranked as among the most serious evidence that has yet been presented, and will be noticed in a future number of *Science.* Messrs. Schmoll and Mabire describe very similar experiments, but conducted with far less caution and insight. Failures are overlooked as unimportant. Just at the point where one desires most accurate information, the account is vague. The percipient is allowed too many trials, is too clearly informed of his success. The series in which the conditions were most convincing "produced only failures." The repeated statement of the percipient after seeing the object he was to think of, that at first this had come to his mind but was rejected, is recorded with great *naïveté.* Such illusory instructions as that the agents must entertain no "secret hope of failure" are seriously recorded. All this renders these observations of little weight.

Mr. Gurney contributes two articles. In the first he describes some curious experiments in hypnotism, in which the subject is given an hypnotic suggestion to write such and such a word, and when awakened is utterly unable to recall the word, not even by an offer of money; but when seated at the planchette he unconsciously, or, as Mr. Gurney prefers, automatically, writes the word without knowing what he has written. The variations on this experiment are more curious than valuable; but the cardinal idea is a happy one, and promises to shed new light on the *rôle* of memory in hypnotic states. Many of the author's deductions from and explanations of his phenomena will not be indorsed by authorities in hypnotism. In his second article Mr. Gurney argues at great length for the admission of two kinds of suggestion in hypnotism, — the first the recognized physical suggestion; and the second a purely psychical suggestion, acting without contact and at a distance. He traces the relations and analogies of the one to the other, and marks off the boundary-lines of the two. All of this is decidedly premature, but it serves a useful purpose in singling out the very point upon which further study should and will be directed. Can the increased sensibility, the astounding subtlety, and the marvellous shrewdness of hysterical hypnotics account for the observed phenomena, taking into account the difficulties of a complete observation and our ignorance of the possibilities of deception, or must we introduce an agency new to the domain of science? Quite relevant in this connection is the footnote of Mr. Gurney's, pointing out that hypnotic subjects easily establish a fashion, and that here is the clew to the differences between the schools of Paris and of Nancy; and it may be added, that an omission of a factor such as this would make a telepathic fact of what, under this view, is only a shrewd and largely unconscious acting-out of a suggestion.

Among the critical notices, Mr. F. W. H. Myers writes a very matter-of-fact account of the work of the Seybert Commission, and describes some observations of Professor Foutan on seeing with the fingers, and hearing with the fingers, the chief feature of which is their incredibility. Mr. Myers overestimates their value, and they must be corroborated before they can rank as facts at all.

What in many ways is the most important and interesting contribution in the number is to be found on the last two pages. Here we are told that the Creery girls, from whom experimental evidence of telepathy had been gained, were detected in the use of a code of signals. They had both a visual and an ordinary code; and, though these codes may not have been used on all occasions, it throws discredit on all results obtained through their agency. If scientific observers can thus be deceived by young girls, — inexperienced, and apparently perfectly sincere girls, — ought not this to impress upon every investigator the profound importance of acquainting himself with the possibilities of deception, and perhaps to conduct his observations on the principle of the detective who held every one to be criminally inclined until proven to be honest?

Looking Backward. By EDWARD BELLAMY. Boston, Ticknor. 16°. 50 cents.

THE preface to this work is dated in the year 2000, and its object is to show the state of society which in the author's opinion is destined to prevail at that time. The author, being a novelist, has written the work in the form of a story, the principal actor in which, Mr. West, tells his own tale. He goes into a trance in the year 1887, and awakens in the year 2000, when he finds himself in a society so different from that he had been accustomed to, that it took him some time to get acquainted with it. This society is based on State socialism in the most extreme form. All industry is controlled by the national authorities at Washington, the individual States as well as all private corporations and capitalists being done away with. The authorities are almost exclusively occupied with managing the national industry, but little legislation being needed; for the people are all so very good, that they have no disposition to wrong each other, the few cases of crime that occur being regarded as examples of 'atavism.'

This amazing moral improvement, our readers will understand, is entirely due to the equal distribution of property. Every individual has an equal share with every other in the national industry, so that there is no check on the increase of population. On the other hand, every one is required to work according to his abilities; yet the men of the new era are represented as loving each other so very much that they are perfectly satisfied with this arrangement. Moreover, the wealth of the world is so enormously increased, that everybody lives as luxuriously as the richest folks do now. In short, the book depicts the usual socialistic Utopia, with many refinements of detail.

The absurdity of the whole thing is evident from various considerations. Besides the difficulty of managing such a colossal industrial system in the way supposed, — a difficulty which the author of the book fails entirely to appreciate, — the social order here exhibited assumes such an increase of wealth as could not possibly take place without mechanical or other inventions such as have not yet been even dreamed of, and which Mr. Bellamy does not even hint at. For, not only are all men to be rich under the coming *régime*, but they are not to work more than five or six hours a day, and are to cease work entirely at the age of forty-five. The idea advanced by the author, that such a vast increase in the production of wealth will result from a mere change in the mode of distribution, is preposterous.

Again: Mr. Bellamy's scheme assumes the possibility of a moral improvement such as cannot be made in less than some thousands of years, if indeed it ever can be. The theory that all wickedness and crime are due to the unequal distribution of wealth is contradicted by every man's personal consciousness and of all that we know of human nature. It should be added, that Mr. Bellamy's ideal of human happiness is any thing but a high one, for it consists mainly in 'easy and agreeable relaxation:' and he expressly says that 'bread and games' are the prime necessaries of life. In short, the book describes a state of society and of human life that is not only impossible, but in many respects as undesirable as it is impossible.

Memory and its Doctors. By Dr. E. PICK. London, Trübner. 12°.

Memory: What it is, and How to improve it. By DAVID KAY. London, Kegan Paul, Trench, & Co. 8°.

"Loisette" exposed, together with Loisette's Complete System of Physiological Memory. By G. S. FELLOWS. New York, The Author. 8°. 25 cents.

ALTHOUGH the search for the philosopher's stone has been abandoned, and men have come to agree that there is no royal road to knowledge, still one can often detect in many a mind a lurking fondness for the belief that there may possibly be some undiscovered short cut to mental attainment which a modern Raymond Lully or Ponce de Leon may reveal in a few lessons under the inspiration of a proper fee. It seems not a rash assumption to make, that, of the many thousands who within a few years have paid tribute to a certain 'American memory professor,' not a few came with the secret hope of emerging from the five lessons with their entire mental furniture put into perfect order and vastly improved. While these people lend a willing ear to the physiologist when he explains to them how mental acquisition is related to organic growth; how everywhere normal growth is a gradual, assimilative, and digestive process, not to be hurried by overdosing and cram; yet they have not the necessary faith to apply this knowledge to the particular case in which they are interested. This, together with a successful advertising machinery and production of testimonials, must largely account for the phenomenal success that has attended this professor of memory.

Remarkable memories have from ancient times attracted a good deal of attention. Especial attention seems to have been given to the subject of artificial memory throughout the sixteenth, seventeenth, and eighteenth centuries. Dr. Pick gives a convenient sketch of the history of the topic. Petrus de Ravenna is said to have played a game of chess, and to have dictated two letters on stated topics at the same time that dice were thrown and the throws recorded. When the game was over, he recited all the moves of the game of chess, all the words of the two letters backwards, and each throw of the dice in order. System after system of mnemonics was proposed, each promising more than its predecessor, and all painfully artificial. The association of dates and items to be remembered visually with the compartments of an imaginary house, or orally with the names of the letters, with numbers and harsh com-

binations of meaningless sounds, of which the 'Barbara, celarent,' etc., is a typical survival; the translation of letters into numbers and associations formed on ridiculous principles, seasoned with wretched puns, — all these flourished, and had their day. One doctor even invented a pill that would improve the memory; while another announced with great *éclat* that the seat of the memory is the occiput, and that roasted fowl, small birds, and other delicious things, acted favorably on this organ. Even the pledging of the pupils to secrecy is not a new invention. These systems have been well likened to the keys, with enormous brass stars attached, that one gets on steamboats. The object of the appendage is to prevent one from forgetting to leave the key behind, but the encumbrance one has to carry to secure this end is a greater annoyance than the task of remembering to return the key.

Only in very recent times has the scientific study of memory as a psychic function been seriously undertaken, and the subject been popularly treated in a sound manner. The name of Dr. Pick deserves to be mentioned as among those who first broke away from utterly artificial systems, and, while modestly claiming the success of his teaching, presented the topic on a natural basis. His present volume is mainly a reprint of former lectures, with a history of mnemonics, and a series of testimonials of the success of his teaching. It seems to have been brought out by the unjust use of his work by Loisette.

Dr. Kay's work has many points that deserve high commendation. "The author has little faith in arts for improving the memory in two or three lessons, but he has unbounded faith in systems of education, properly conducted, to effect incredible improvements in this direction." Accordingly he approaches the problem from a broad psychological point of view, with no haste to suggest startling practical results. A very small portion of the book is devoted to a study of what is currently understood as memory. The main object is to show the position of memory in the hierarchy of mental powers, and set forth the modern doctrine of its physiological concomitants. An entire chapter is devoted to the relation of body and mind; an equally full description of the senses and their mode of acquiring information is given; the nature of mental images, and the *rôle* of the unconscious, are similarly treated. We are then prepared to consider the special processes upon which a good memory depends. First and foremost is close and accurate attention to the impression at its first appearance. The attention must be trained, and sense-perception made quick and accurate, if memory is to be retentive. Not less important is the association of our knowledge by natural links, and along the lines of our own interests. It is only by such means that a serviceable memory can be developed, if by memory we mean, not the power of performing a few striking mental gymnastics, but the power of having our knowledge ready to hand, and carrying it with little effort. That this problem changes its character with each individual, goes without saying. Mr. Kay's book is full, in fact over-full, of citations from various authorities, and is an admirable book to put in the hands of an intending student of the subject. It is a pity that his physiology is sometimes at fault, that his authorities are at times promiscuously chosen, and especially that he has not taken advantage of the most recent technical studies of the memory, of which the work of Dr. Ebbinghaus is so excellent a type. These seem to be omitted because they are in a foreign tongue. From the liberal use that Mr. Kay makes of translated works, one can infer how much his book would have increased in value had he gone to the originals.

The last volume on our list has little claim to serious consideration, were it not for the practical service that a knowledge of its purpose may render. Mr. Fellows here prints the whole of Loisette's lesson-papers, urging that they have not been copyrighted, and that his signature to a pledge of secrecy was secured on false pretences. He furthermore gives evidence that casts a serious doubt upon the honesty of Loisette's career. The system itself is certainly a most wonderful combination of the endless repetition of a few cant expressions; of persistent reference to the originality and excellence of the Loisettian method, duly emphasized by Italics and bold type; of most careful prescriptions against breathing an atom of this sacred information; and of a general unacknowledged selection from previous writers on the topic. A sentence will probably suffice to illustrate the tone of the teaching: "My Discovery, so far as it pertains to this Lesson, demonstrated *what had never been suspected by any one before*, — that all memories — the strongest as well as the weakest — are PRODIGIOUSLY STRENGTHENED in both Stages by learning and reciting forwards and backwards, or, what is better still, by *making* and *repeating* from memory both ways a series of from 100 to 500 words arranged in conformity to the three Laws given below, which Laws were revealed to me, on their Physiological, or only true side, by my Discovery." It is certainly surprising that this 'system' should have met with the success it had; and it is hoped that its publication in this form will not only prevent the swelling of the list of the victimized, but will warn all against any one who advertises a royal road to any mental acquisition the gate of which is opened only by a fee and a pledge of secrecy.

The Animal Life on Our Sea-Shore. By ANGELO HEILPRIN. Philadelphia, Lippincott. 12°. 50 cents.

THIS is a handbook on the local fauna of Philadelphia and of the much-frequented New Jersey and south Long Island coasts, which will certainly prove extremely interesting to all who care to know something of the animal forms they may see during their summer vacations. The book may be relied upon as being thoroughly accurate; but it is in no way hard reading for the unscientific, and tells them just what they want to know, which is what they may see by the seashore, and where to see it, at the same time giving in each case the life-history of any specimen they may procure. We already have Emerton's 'Life on the Seashore,' designed for the New England coast, and this little book covers another region largely frequented during the summer season. It treats of the shell-fish, the jelly-fish, the star-fish, the worms and sponges, and some coastwise fishes.

NOTES AND NEWS.

THE letters in recent numbers of *Science* describing a peculiar form of northern lights serve to call to the mind of the editor of the *Progressive Age* a sight that he witnessed in August of last year when on board the steamship 'Ozama,' passing along the north-east coast of the island of Santo Domingo, and near to the northern entrance to Mona Passage which connects, between the islands of Porto Rico on the east, and Santo Domingo on the west, the Atlantic Ocean on the north, and the Caribbean Sea on the south. "We were southward bound, and the hour was about nine o'clock at night. The moon was at its full, or thereabouts, and very bright, as is the case in the tropics, especially in the summer season. The sky was entirely clear at the time, with the exception of a small cloud forward of the ship some distance, but between the moon and the coast, which is low and flat for many miles at that part. Suddenly a sharp shower of rain commenced to fall from the cloud, and immediately there appeared over the land, apparently close to the edge of the coast, the most perfect and beautiful rainbow it has ever been the pleasure of the writer to see. Everybody but the writer and the captain, who was on the bridge, were below at the time. The latter said it was the first occurrence of the kind that had come under his observation. That was certainly the case with me."

— The number of words in a person's vocabulary has been frequently and variously estimated. The old philologists thought that few persons used more than ten thousand words, while the ordinary unlettered man possessed from three thousand to four thousand words. It is well known that Shakspeare's vocabulary includes fifteen thousand words, and Milton's eight thousand words. A Swiss writer, M. Edmont de Beaumont, has recently made estimates far in advance of these. He maintains that rustics have at their command as many as seven thousand words; artisans, ten thousand; tradesmen, fifteen thousand; men of culture, twenty thousand; and university graduates, twenty-five thousand. The minimum number of words "without which one makes a pitiful figure in a conversation among cultivated persons is ten thousand." M. Beaumont himself claims to have the use of twenty thousand words in several languages.

— An entirely new machine has been invented for printing postal-cards from the roll, and to turn them out packed in bundles of twenty-five. It prints the cards at the rate of three hundred a minute in the usual way, by means of a rotary press. A set of knives then cuts the cards off, and drops them four abreast into little cells especially prepared for them. When twenty-five cards have dropped out, a set of steel fingers turns the pack over, twines a paper band about it, and pastes it together. The packages are caught in an endless belt of buckets, which carry them into an adjoining room, where they are received by girls, who place them in boxes ready for delivery. One man can look after two machines.

— According to the *Engineering Journal*, the new Argentine-Pacific Railroad from Buenos Ayres to the foot of the Andes has on it what is probably the longest tangent in the world. This is 340 kilometres (211 miles) without a curve. It is also a remarkable fact that in this distance there is not a single bridge, and no opening larger than an ordinary culvert. The level nature of the country will be appreciated from the statement of the further fact that on the 340 kilometres there is no cut greater than one metre in depth, and no fill of a height exceeding one metre. The country, in fact, seems to be almost an ideal one for railroad-construction. There are some drawbacks, however, one being that there is almost an entire absence of wood on the plain across which the western end of the road is located. This has led to the extensive use of metallic ties, which will be used on nearly the entire road. Work has already been begun on the mountain section of the road, which is to cross the Andes and unite with the Chilian line.

— The *Engineering Journal* comments on the contest between armor-plates and projectiles, which has been renewed abroad. Some recent experiments with steel and composite plates made in England seem to indicate that for the present the projectiles have the worst of it. On the other hand, it is announced that the Krupp Company is now building at Essen the largest gun yet made: it is for the Italian armor-clad 'Sardegna,' and will weigh 139 tons, will be 52½ feet long, and have a bore of 15.7 inches. This gun will, it is stated, fire a steel shell weighing 1,630 pounds, with an initial velocity of 2,630 feet per second, or a heavier shell of 2,300 pounds, with an initial velocity of 2,100 feet. It is expected by the makers that this projectile will be able to knock out of time any armor-plate now afloat, and that there will then devolve upon the other side the problem of building a vessel which can float armor-plates heavy enough to resist these shells.

— From statistics based on the census of 1886, it appears, that, of the 51,600 families applying to the authorities for aid in Paris, 2,739 were foreign, comprising more than 7,000 persons. Of 100 heads of families of foreign origin, 27.31 were German; the English only figured in these statistics for 0.95; the Austrians, for 1.79; the Spanish, for 1.06; the Dutch, for 6.97; the Italians, for 7.12; the Russians, for 3.36; the Swiss, for 5.44; the Roumanians, Servians, and Bulgarians, for 1.31. Of 1,000 foreigners living in Paris, 253 were Belgians; 168, Germans; 71, English; 29, Austrians; 21 Spanish; 91, Dutch; 125, Italians; 42, Russians; 132, Swiss.

— On the 20th of June last, M. H. Lecoq, accompanied by an aeronaut, ascended, at quarter-past seven in the morning, from Paris, in a balloon of 700 cubic metres capacity. The balloon quickly reached a height of 600 metres, and moved towards the south-east. The sun appeared as a bright red disk, and it lighted Paris with a yellowish light, producing a most singular effect. After having crossed the Seine above the Isle of St. Louis, about half-past eight M. Lecoq saw that the thunder-cloud which had commenced to form when they started was approaching rapidly, and it was not long before they heard the thunder. Immediately the balloon, influenced by the electric attraction, rose towards the cloud, accompanied, or rather preceded, by the pieces of paper which the balloonists had thrown from their basket. At twenty minutes of eight, and at a height of 1,100 metres, the balloon entered a cloud-mass of a greenish-gray color, which immediately shut out from them all sight of the earth. Even the guide-rope could not be seen for more than a few metres. The cloud was illuminated by intermittent flashes, immediately followed by short peals of thunder. The balloon constantly rotated, and ascended and descended, without the interference of the balloonists; and, what is a rare thing in a balloon, they felt almost constantly a very considerable wind, which shook the balloon, and gave to the basket a swinging motion of considerable amplitude. Soon the storm broke with its full force, and the lightning was followed immediately by the thunder. M. Lecoq states that neither he nor his companion felt any ill effects further than the oppression which is always experienced in an atmosphere highly charged with electricity. On the ropes of the balloon he observed some manifestations of St. Elmo's fire. At certain times a sensation as of a current of cold air was very perceptible. This was followed immediately by a rapid ascension, and the expelled gas descended even to the basket. During one of these ascents the balloon reached a height of 1,600 metres, which was the maximum. At this height the storm was at its greatest force. The discharges of lightning took place between a cumulus-cloud, in which floated the balloon, and the cirrus-cloud above. The ascension was especially interesting on account of the long time during which the balloon staid in the thunder-cloud, — a circumstance which rarely occurs. M. Lecoq was specially impressed by the violent movements of the air, and by the rapid ascents and descents which took place in the middle of the electrified cumulus, as if due to a powerful attraction which affected the balloon and light bodies floating in the air.

— The total number of European troops in English India in 1886 was 61,015, and the average death-rate per thousand was 15.18; in the province of Bengal there were 39,000 men, and the death-rate was 15.5; in the province of Madras, 11,000, and the death-rate 16.2; province of Bombay, 11,000, death-rate 12.7. The number of native troops was 106,010, and the death-rate was 19.46 per thousand.

— Some eighteen months ago the French Senate passed a law providing for civil or religious funerals, and for burial or cremation, according to the desires of the parties interested; but as yet the administrative authorities have not determined on the conditions to be observed in the different modes of disposing of a body, and as yet Paris is without a proper crematory. Early in the year a commission was sent to Milan and Zurich to investigate the crematories in use in those cities. This commission reports that the Italians are not better off in Milan than the French in Père Lachaise. Cremation at Milan lasts two hours; at Paris it lasts an hour and a half, with an expense of from fifteen to twenty francs. The commission estimates that the time is too long, but that the expense cannot be reduced. They hope to be able in a few months to effect a cremation in from one-half to three-quarters of an hour at the outside. In this connection, it may be mentioned that there exists in Paris a society for the advancement of cremation, numbering at present six hundred members. It seeks by all legal means to assure every person who desires it that his body shall be cremated after death. Membership does not imply any engagement to accept this method, but leaves complete liberty of choice.

— Late research in this country and in Europe implies that some plants have the power of getting nitrogen from the air. How they obtain it, how much is gathered by the foliage, and how much comes through the soil and the roots of the plants, are things to be found out. If there are plants that can draw this scarcest and costliest of all the elements of plant-food from the air, it is important to know what plants they are, and the circumstances under which they get it. If the nitrogen must first be introduced into the soil by natural processes or by manuring, we need to know how this can be done most economically. How much nitrogen plants can obtain from the atmosphere, is a problem best studied by experiments on a small scale in the greenhouse and laboratory. For the investigation of this latter question, which has a high scientific as well as practical importance, Storrs School Agricultural Experiment Station at Mansfield, Conn., has begun a series of experiments in pots by the method of sand-and-water culture. Late research implies that the minute organisms called microbes or bacteria may have something to do with the acquisition of atmospheric nitrogen. This especial problem is being studied in connection with the experiments on nitrogen-supply under the immediate supervision of the director, Prof. W. O. Atwater.

— *Nature* states that the vapor-density of sulphur has been redetermined by Dr. Biltz in the laboratory of Prof. Victor Meyer with unexpected results. It has hitherto been generally accepted that at a temperature (524° C.) not very far removed from its boiling-point (447° C.) the molecule of sulphur is built up of six atoms. This assumption is based upon vapor-density determinations by Dumas and Mitscherlich, who obtained values about this temperature pointing to a hexatomic molecule. However, the work of the last few years upon the chlorides of aluminium, tin, and iron, has opened the eyes of chemists to the fact that the double formulæ Al_2Cl_6, Sn_2Cl_4, and Fe_2Cl_6, resting as they did upon a few experiments performed within a very limited range of temperature, are erroneous, and have no foundation in fact. The older work upon the constitution of sulphur molecules was notably of this class. The experiments themselves were irreproachable, and completed with all the skill for which the experimenters were famous; but unfortunately the temperatures at which they worked were not sufficiently removed from each other, there being only a difference of 27° C. between their maxima and minima. It is now, moreover, a demonstrated law that the existence of molecules of fixed composition can only be assumed when the vapor-density remains constant within a notable interval of temperature: hence a series of fresh determinations have been undertaken in the case of sulphur. Experiments conducted at 518° in a bath of vaporized pentasulphide of phosphorus by Dumas's method gave values averaging about 7.0, which are nearly coincident with Dumas's own. At the higher temperature of 606°, using a bath of stannous chloride vapor, the density had diminished to 4.7. At 860°, as is well known, sulphur vapor attains the normal constitution of two atoms to the molecule, and the density remains constant for about 200° higher still: hence, in order to finally set the question at rest, a series of ten determinations were made at intervals of about 10°–15° from 468° to 606°, with the conclusive result that the density regularly diminished from 7.9 at the former, to 4.7 at the latter temperature. Hence the notion of S_6 is completely dissipated: there is no more experimental reason for it than there is for the existence of molecules of the constitution S_5 or S_n. None but the value corresponding to the normal composition, S_2, stands the test of interval of temperature: therefore we must conclude that sulphur obeys the usual law, and that its molecules when completely vaporized are each composed of two atoms.

— The following comparison of several physical measurements of men belonging to the "upper professional classes, well fed, well clothed," with Cambridge students, suggests interesting reflections on the superiority of university men: —

	Height.	Pull.	Squeeze.	Breadth.	Weight.
Cambridge men......	68.9	83	87.5	25.4	153.6
Non-university men..	67.9	74	85	21.9	143

— In *Wide Awake* for July, Sallie Joy White writes of Helen Keller, to whom we have already referred, "The ideas of death and burial had never been communicated to her; but, taken into a cemetery on account of some beautiful flowers there, she grew pale and grave, and put her little hand upon her teacher's eyes and her mother's, and spelled out 'cry, cry,' and her own eyes filled with tears. Her teacher says that one day when her brother was coming toward them, as they were walking, Helen knew it, spelled his name repeatedly, and started in the right direction to meet him; and that she gives the names of people she meets walking or riding as soon as their presence is recognized; and that often, when she is about to make known some plan, the child will anticipate her and spell out the very plan about to be unfolded. Whether this be the action of some sharpened sense already known to us and named, or the awaking and working of some sense not recognized and named, is interesting matter for study."

— G. Stanley Hall has accepted the presidency of Clark University, Worcester, Mass. The two following extracts, the first from the letter tendering the position, the second from Professor Hall's letter of acceptance, throw some light on what may be the policy and character of the as yet unformed institution. The trustees write, "In the work to which you are thus called, the trustees promise you a hearty and unselfish co-operation. They desire to impose on you no trammels. They have no friends for whom they wish to provide at the expense of the interests of the institution, no pet theories to press upon you in derogation of your judgment, no sectarian tests to apply, no guaranties to require, save such as are implied by your acceptance of this trust. Their single desire is to fit men for the highest duties of life, and to that end that this institution, in whatever branches of sound learning it may find itself engaged, may be made a leader and a light. To this high purpose they have dedicated their university, and, in calling you to the first position of influence and authority for its accomplishment, they give you their present confidence, and the assurance of sympathy, co-operation, and support." Dr. Hall replied, "The work of organizing another college of the old New England type, or even the attempt to duplicate those that are best among the established institutions, old or new, would not induce me to leave. But as I have come to know the rare educational wisdom, as well as the rare munificence, of your founder; the single and express desire of the corporation, that, in whatever branches of sound learning it may engage, the new university may be a leader and a light; the many advantages of location afforded by your city, which seem to make the place of this great foundation no less auspicious than is the present time; the public co-operation, interest, and good-will of your citizens; and as I realize how these influences, once fairly organized, must tend in this day to still further university progress along old lines and the opening of new ones, — I am drawn with hope and enthusiasm, too strong to resist, from this present to the future service to which you call me."

— The value and popularity of the general government exhibits at the great fairs in this country are becoming so universally recognized, that Congress is asked to authorize the sending of such exhibits to every important exhibition that is held. The latest applicant is the Virginia Agricultural, Mechanical, and Tobacco Exposition, to be held in Richmond from Oct. 3 to Nov. 21 of the present year. The sum asked for is twenty-five thousand dollars, five thousand each for the Agricultural Department and the Fish Commission, and fifteen thousand for the Smithsonian Institution and National Museum. It would be establishing a rather dangerous precedent to send a government exhibit to a State fair, for every other State in the Union will immediately demand that the interest in their State fairs shall be promoted by an appropriation by Congress.

— In a recording rain-gauge recently devised by M. Brassard, as described in *Nature*, the water passes from the bottom of the receiver into a centrally pivoted trough, having each arm slightly depressed in the middle. It fills the two divisions alternately. The filled arm goes down, and empties itself into a lower trough, and the rocking thus caused is registered by an ordinary counter. Each rocking of the trough indicates one-tenth of a millimetre of water having fallen into the receiver. The instrument is designed to eliminate the error usually arising from evaporation.

— Advices from the fishing-village of Kerschkaranza, in the Kola Peninsula, on the White Sea, state, according to *Nature*, that on Jan. 5 a curious and destructive phenomenon occurred there. At 4 A.M. the inhabitants were awakened by a peculiar, dull, heavy detonation like that of distant artillery. Piled up to a height of several hundred feet, the ice — in consequence, no doubt, of the enormous pressure of the ocean-ice without — was seen to begin moving from the north-west towards the shore. The gigantic ice wall moved irresistibly forward, and soon reached the shore and the village, which it completely buried, the ice extending a mile inland. The forward movement of the ice lasted four hours. No lives were lost.

— According to the report of the inspector of schools in Hong Kong for the past year, as noticed in *Nature*, the total number of schools subject to government supervision was 94, as against 45 in 1877 and 13 in 1867; the numbers of scholars for the corresponding years being respectively 5,974, 3,144, and 700. Of the 5,974 pupils who attended schools under government supervision in 1887, 4,160 attended missionary schools, and 1,814 the government undenominational establishments. In the colony there are five classes of

schools: (1) Chinese, where a purely Chinese education is given; (2) Romanized Chinese, in which a European education is given in the Chinese language; (3) Portuguese, where a European education is given in the Portuguese language only; (4) Anglo-Chinese schools, numbering eight, with 1,160 scholars; (5) English schools, numbering six, with 688 scholars, in which the children are taught in the English language only. The Government Central School presented 384 boys for the annual examination, and of these 375 passed; that is, the very high percentage of 97.65. At this latter school the subjects taught are reading, dictation, arithmetic, Chinese into English, English into Chinese, grammar, geography, map-drawing, composition, Euclid, algebra, mensuration, history, and Latin.

— *Nature* is authority for the statement that on April 29, when off the Westman Islands, Iceland, the captain of the Danish mail-steamer 'Laura' threw overboard a letter written in Danish. On May 6 the letter was found in the stomach of a cod caught by a French fisherman off Reykjanæs, about one hundred and twenty miles distant. The man showed it to the French consul at Reykjavik, who submitted it to the captain of the 'Laura.' It was much decomposed, but still readable.

— There being no provision in this country for the accurate comparison of electrical standards and apparatus, it has been decided to provide means for such measurements at Johns Hopkins University. The work will be under the general direction of Professor Rowland and under the immediate supervision of Dr. Duncan. The comparisons will be made by G. A. Liebig, Ph.D., who has been appointed assistant in electricity. The importance of such provision for the comparison of standards has been for some time recognized. Such representative bodies as the American Association for the Advancement of Science, and the National Electrical Conference, held in 1884 at Philadelphia, have discussed the possibility of a bureau of standards, and have favored its establishment. It is not probable that the government will take any steps in the matter, at least for the present, and, as time goes on, the need becomes more pressing. There is needed some laboratory where instruments can be compared with standards of undoubted correctness, by accurate methods and careful observers, under uniform and determinate conditions. These requirements are filled by the standards and apparatus in the possession of this university, and by the facilities and experience that the laboratory offers.

— A new and greatly improved edition of the photographic map of the normal solar spectrum, made by Prof. H. A. Rowland, extending from the extreme ultra-violet down to and including B to wave-length 6950, is now being printed. The old map, published in 1886, was made by means of a grating ruled on the old dividing-engine, which was originally intended for only small gratings. Furthermore, it was not printed in a sufficiently careful manner; and the negatives, which were originally none too good, soon became broken or defaced, so that many of the prints, especially the later ones, were not satisfactory. The whole work has now been gone over again. A new dividing-engine to rule large gratings has been constructed, and has proved to be superior in every way to the old one, although the old one is almost equal to it for small-size gratings. Several concave gratings of 6 inches diameter and 21½ feet radius have been ruled with 10,000 or 20,000 lines to the inch, giving definition hitherto undreamed of. Professor Rowland has devoted years to the making of dry plates, simple and orthochromatic, and is thus better prepared than before for the work of making the map. He has also revised his list of standard wave-lengths, and extended them into the ultra-violet, and has placed the scale upon the photographs with greater care than before.

— Bulletin No. 4 of the Ohio Agricultural Experiment Station discusses some elaborate experiments in preventing curculio injury to cherries, and treats in a practical way the best midsummer remedies for the chinch-bug, which has lately appeared in destructive numbers in Ohio. In the cherry experiment, which was conducted by the station entomologist, Clarence M. Weed, 22,500 cherries were individually cut open and examined, and the conclusion reached that three-fourths of the cherries liable to injury by the curculio can be saved, without danger to the user, by spraying with a solution of London purple soon after the blossoms fall. This bulletin will be sent free to any Ohio farmer who will address Ohio Agricultural Experiment Station, Columbus, O.

— At a meeting of the Paris Academy of Sciences, July 2, there was presented a series of drawings of the planet Mars made by M. Perrotin, director of the observatory at Nice. In the discussion which followed, M. Fizeau offered an explanation of the singular canals observed on the surface of Mars, which resemble slightly canals used for irrigation. The explanation which he gives is, that on the surface of Mars there must be large glaciers similar to those which exist on the earth, but of an extent far greater, and that the movements and crevasses are much more pronounced. This hypothesis, as M. Fizeau claims, accords perfectly with our present knowledge of the planet. We know, first, that the seasons are twice as long as on the earth; second, that the force of gravity is feeble; third, that the temperature is probably much lower than that of the earth; and, fourth, that the atmosphere is less developed than that of the earth, less extended, and consequently less able to absorb and preserve the solar heat.

— The Royal Society of New South Wales offers its medal and a money prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects: — to be sent in not later than May 1, 1889, 'On the Chemistry of the Australian Gums and Resins' (the society's medal and £25), 'On the Aborigines of Australia' (the society's medal and £25), 'On the Iron-Ore Deposits of New South Wales' (the society's medal and £25), 'List of the Marine Fauna of Port Jackson, with Descriptive Notes as to Habits, Distribution, etc.' (the society's medal and £25); to be sent in not later than May 1, 1890, 'Influence of the Australian Climate, General and Local, in the Development and Modification of Disease' (the society's medal and £25), 'On the Silver-Ore Deposits of New South Wales' (the society's medal and £25), 'On the Occurrence of Precious Stones in New South Wales, with a Description of the Deposits in which They are found' (the society's medal and £25). The competition is in no way confined to members of the society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the council for the time being; neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor.

— Senator Hoar, in his recent oration at the Marietta centennial, spoke of the Ordinance of 1787, by which the North-west Territory was established, as "one of the three little deeds of American constitutional liberty." "It belongs," he said, "with the Declaration of Independence and the Constitution." Yet how many Americans, even good scholars, have ever read the Ordinance of 1787? Few would know where to look for it, and, looking, would probably find it only in the appendix to some obscure and dusty volume. Many, therefore, at this time will be glad to know that the directors of the 'Old South Studies' have incorporated it in their new general series of 'Old South Leaflets,' which are published for schools and the trade by D. C. Heath & Co., Boston, and that it is now ready for distribution. These 'Old South Leaflets,' which sell for the small price of five cents a copy or three dollars per hundred, are the means of bringing a great number of important original documents into the service of our historical students. —— Ginn & Co. will publish shortly a 'Manual of Astronomy,' by Prof. C. A. Young of Princeton College. —— The first number of a new monthly journal devoted to physics was published in St. Petersburg in May. The object of this journal is to give each month a *résumé* of progress in the science. —— E. & J. B. Young & Co. will publish shortly 'The Last Journals of Bishop Hannington.' The volume will be somewhat a continuation of the 'Memoirs of Bishop Hannington,' though, of course, treating altogether of the later years of his life, and of his work in Africa. —— G. P. Putnam's Sons have in preparation 'Omitted Chapters of History Disclosed in the Life and Papers of Edmund Randolph, Governor of Virginia, First Attorney-General United States, Secretary of State, etc.,' by Moncure D. Conway. The volume will contain copies of a large number of

unpublished documents from the British and French foreign offices. —— George Routledge & Sons will publish shortly 'The Handy Reference Atlas of the World,' by John Bartholomew, containing 100 maps and plans, a complete index, and geographical statistics. —— D. C. Heath & Co. have ready a collection of twenty-five models and twenty-five photographs by N. S. Shaler, William M. Davis, and T. W. Harris, instructors in geology in Harvard College, designed to show the principal features in the structure of the superficial aspects of the earth's crust, with extensive text descriptive of each figure, prepared for the use of beginners in geology. This collection is now in use in the laboratory of Harvard College, by the Boston School of Natural History, and a dozen other schools of various grades. Messrs. Heath & Co. will also publish very soon an 'Illustrated Primer,' by Sarah Fuller, principal of the Horace Mann School for the Deaf, Boston. The aim of this little book is to familiarize the deaf children with the printed forms of words and sentences which they have learned to speak. To associate these with the objects, there are introduced many simple cuts of common objects with which the pupils are acquainted. —— Harper & Brothers have just issued a handsomely illustrated work, entitled 'The Capitals of Spanish America,' by W. E. Curtis, in which all the great cities in the central and southern parts of this Western continent are described at length, and their ancient history retold. —— 'The Injurious Influences of City Life' is the subject of a brief but striking paper, by Walter B. Platt, M.D., to appear in the August *Popular Science Monthly*. The limitation of muscular movements, the noise, and the pavements in a city, are the principal sources of the effects to which he refers. —— Messrs. Eyre & Spottiswoode, London, have issued two new volumes of the 'Report on the Scientific Results of the Voyage of the "Challenger,"' — Vol. XXIV., 'Zoölogy (2 parts, text and plates), Report on the Crustacea Macrura;' Vol. XXV., 'Zoölogy, Report on the Tetractinellida.' —— Roberts Brothers have just ready 'Harvard Vespers,' a collection of the sermons preached to the students by Phillips Brooks, E. E. Hale, A. P. Peabody, and Dr. Gordon, of the Old South, Boston. —— D. C. Heath & Co. will publish shortly some selected poems from Lamartine's 'Premières et Nouvelles Meditations.' They will be edited, with biographical sketch and notes, by George O. Curme, professor of German and French, Cornell College, Mount Vernon, Io. —— The University Publishing Company will hereafter publish Prof. A. Knoflach's works on 'German Simplified' and 'Spanish Simplified.' These works, heretofore published by the author, have had a fair sale, which it is hoped will be extended by the transfer to an enterprising firm like the University Publishing Company. —— Funk & Wagnalls have just ready 'Nobody Knows,' by A Nobody, which deals with what the author calls 'social wrongs.' —— Houghton, Mifflin, & Co. announce 'Political Essays,' by James Russell Lowell, which will doubtless attract remarkable attention. Most of the essays date back to the time of the war and the reconstruction which followed. The closing paper is his New York address in April last, on 'The Place of the Independent in Politics.' —— Harper & Bros. have issued 'The Names and Portraits of Birds which interest Gunners,' containing descriptions of birds generally shot in the eastern portion of the United States, and giving the different names by which they are commonly known in other parts of the country.

— At a meeting of the French Academy of Sciences, July 2, Prof. S. P. Langley was elected a corresponding member.

— In June, 1887, a committee of the Howard Association invited the co-operation of their friends and the public to enable them to issue, and distribute at home and abroad, certain works which their secretary, Mr. Tallack, had prepared, embodying important facts, figures, and observations collected by the association during the past twenty years, in reference to prison discipline and the best methods of the treatment and prevention of crime, together with the questions of intemperance and capital punishment. The works alluded to are now nearly ready for the press, and are three in number. It is hoped that they may each be issued during the year 1888. The contents of two of these books will include the following subjects: — 'Prison Discipline, and the Best Modes of the Treatment and Prevention of Crime,' including chapters on the existing British, continental, and American systems of prison and penal discipline; separation and association in jails; prison visitation; penal labor; prison officers; the police; imprisonment for long terms and for life; the aid of discharged prisoners; habitual offenders; probation and conditional liberation; juvenile delinquency; reformatory and industrial schools; pauper children; sentences; various modes of punishment and prevention, etc.: and 'The Death-Penalty at Home and Abroad,' including chapters on the limits and operation of deterrence and penalty; British and foreign official statistics of murder and its punishment; judicial mistakes; insanity and homicide; the law of murder; American homicide; the prerogative of pardon; modes of execution; the abolition of capital punishment, regular and irregular; perverted clemency; substitutes for the infliction of death; alternative dangers; the opinions, on this question, of John Stuart Mill, Justice Sir Fitzjames Stephen, Lord Bramwell, Prince Bismarck, Earl Russell, Right Hon. Joseph Henley, M.P., Right Hon. John Bright, M.P., King Oscar I., and others; the Bible and capital punishment, etc. The above appeal has been widely issued in the form of a circular. It has hitherto only elicited £62 4s., and this sum has been exclusively contributed by eleven friends who were previously subscribers to the association, and familiar with its services. It is obvious that much more effectual help is necessary to enable the committee to carry out their wishes.

— Germany is taking an interest in the exploration of the Antarctic regions. An expedition is being organized by Dr. Neumayer of the Hamburg Observatory.

LETTERS TO THE EDITOR.

Onondaga White-Dog Feast.

DANIEL LA FORT testified before the legislative committee this month that the Onondagas burned no white dog this year, because the Indian breed had run out. He told me soon after the feast, which occurred as usual, minus the dog, that it was a sacred breed, and no others could be used; and I think none was burned last year. Of course, this is partially an excuse for letting the custom die out, as Indian dogs could be procured from other Iroquois if so desired. The feast has fallen into decay, though its observance in some ways will continue a while longer. The presumption is, that some intelligent Indians are assisting in its gradual disuse. This decay has been quite marked in this generation. Forty years ago, two dogs were burned; twenty years ago, but one, but this was on a blazing pile outside the council-house. Five years ago they opened the top of the council-house stove, and dumped the dead victim into that. Now there is no dog at all.

The last feast attracted some antiquarians from a distance, who were much disappointed at the omission, — Hamlet, with Hamlet left out, — but there was no remedy. The dog had had its day.

It is customary to call this an ancient feast, and to suppose it identical with the white-dog feast of the Senecas, which it much resembles. I have before now pointed out the differences, one of the principal of which is the time at which the dog is killed. With the Senecas this was at the beginning of the principal feast-day, and it remained hung up until the fifth, when it was taken down and burned. Among the Onondagas the killing and burning were always on the same day. The Onondagas had such a sacrifice but once a year; the Senecas, on any important occasion, sacrificing several dogs during Sullivan's invasion in 1779. With them the custom seems but little over a century old, the Onondagas adopting it later, while the other nations may not have had it at all. At least, it has been described only in these two, and that but at a late day. The Onondagas simply added a striking rite to their earlier dream-feast, which had the periodical observance of the later dog-feast. That they had it from the Senecas seems reasonable; but whence the latter obtained it is not so clear. It may prove a late outgrowth of earlier customs, dog's-flesh having been always highly esteemed by the Indians. Unknown, apparently, to the French missionaries, it is already among the things that have been. In a very short time the other rites of the feast will disappear, as feasts themselves have been dropped. I recently had the good fortune to be present at the Onondaga planting-feast, which has never been described. W. M. BEAUCHAMP.

Baldwinsville, July 12.

Publications received at Editor's Office, July 9-14.

BLAIR, A. A. The Chemical Analysis of Iron. Philadelphia, Lippincott. 282 p. 8°. $4.
BOTTONE, S. R. Electrical Instrument Making for Amateurs. 2d ed. London, Whittaker & Co. 183 p. 16°. (New York, Van Nostrand, $1.20.)
HEILPRIN, A. The Animal Life on Our Sea-Shore. Philadelphia, Lippincott. 130 p. 12°. 50 cents.
MURRAY, J. A. H., *ed.* A New English Dictionary on Historical Principles. Part IV. Sections 1 and 2. Oxford, Clarendon Pr. 352 p. f°. (New York, Macmillan, $3.25.)
PEREZ, B. L'Art et la Poésie chez l'Enfant. Paris, Baillière. 308 p. 8°.
SALOMONS, D. Management of Accumulators and Private Electric Light Installations. 4th ed. London, Whittaker & Co. 176 p. 16°. (New York, Van Nostrand, $1.20.)
U.S. GEOLOGICAL SURVEY. Topographical Maps of Portions of Massachusetts, Kansas, California, Missouri, and Maryland. 8 maps, 42 by 50.5 cm. Washington, Government, 1888.
U.S. WAR DEPARTMENT. Annual Report of the Chief Signal Officer of the Army to the Secretary of War for the Year 1887. Part I. Washington, Government. 361 p. 8°.

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SCIENCE

FRIDAY, JULY 27, 1888.

THE WANT OF A COMPLETE REPORT on the mineral resources of Ontario has long been felt, and, in response to the general wish, on the 14th of March last a resolution was carried in the Legislative Assembly authorizing the government to appoint a royal commission to investigate and report on this subject. Acting on this resolution, the Council on the 8th of July appointed the following gentlemen a commission for the above purpose: John Charlton, M.P., Chairman; Robert Bell, Assistant Director of the Dominion Geological Survey, Ottawa; William Hamilton Merritt, mining engineer, Toronto; William Coe, proprietor of iron mines, Medoc; Archibald Blue, Deputy Minister of Agriculture, Secretary of the Commission. The commissioners met the members of the government by appointment in Toronto on Saturday, July 12, when it is understood a programme was agreed upon, the particulars of which, however, have not been made public.

TWO IMPORTANT EXPEDITIONS left Rio de Janeiro in June for exploration and work in two of the least-known parts of the Brazilian territory. The first, sent out by the Ministry of War, under the command of Capt. Bellarmino Mendonçá, is to open a road from the town of Guarapuava, on the frontier of the settled portion of the province of Parana, to the confluence of the rivers Parana and Iguassu, and to found a military colony at the latter point. A road is also to be opened along the Parana river from the mouth of the Iguassu to the navigable portion of the river above the Sete Quedas fall, and from this point to Guarapuava, via the valley of the Piquiry. The founding of a colony at the mouth of the Iguassu, where the Argentines are already establishing themselves, will, aside from its military importance, prove of great value in peopling the valley of the upper Parana, which has been deserted since the time of the expulsion of the Jesuits. By means of the lower Parana the colony will have free water communication with Buenos Ayres and other markets of the Argentine Republic, where two of its natural products, lumber and matte, will find a ready sale. This will give at once to the proposed colony a commercial importance, far beyond that of a purely military station, and will doubtless lead to the rapid spread of population along the upper Parana and its tributaries, with their hundreds of miles of navigable waters. The second expedition, consisting of three military engineers, Capt. Lourenço Telles and Lieutenants Miranda and Villeray, is sent out under the auspices of the Sociedade de Geographia de Rio de Janeiro, the expenses being borne by the Ministry of Agriculture. It is to proceed to Cuyaba in the province of Matto Grosso, pass by land to the headwaters of the Paranatinga, and descend that river and the Sao Manoel or Tres Barras to the Tapajos, returning to Rio de Janeiro via Para by the Tapajos and Amazonas. This exploration will thus be a valuable complement to that of the Tapajos by Chandless, as the Sao Manoel and Paranatinga are almost absolutely unknown.

A FULL REPORT of a recent lecture on personal identification, by Mr. Francis Galton, appears in *Nature* for June 21 and June 28. Mr. Galton here presents a practical application of his favorite pursuit, the accurate description of physical and mental peculiarities. He proposes a very ingenious scale of divergencies from the normal for any one feature, and has even invented a mechanical device by which the tedious labor of arranging a large number of such observations can be much abbreviated. The anthropometrical laboratory, at which any one can, under proper restrictions, have a record made of his chief physical measurements, is now open in London, and promises to yield valuable material for this line of study. In connection with this work Mr. Galton has studied the striations of the human fingers, and is able to corroborate the value attributed to them as a means of identification. These markings are easily obtained, and the variety of them is larger than one would *à priori* imagine. The markings of a finger of Sir William Herschell made in 1860 and 1888 respectively are figured, and show a striking similarity. The difference in age of the two prints testifies to the wearing of the epidermis. The study is still in its infancy; but the success of such measurements for identifying criminals, as exhibited in France, promises to draw more general notice to the subject.

A CABLEGRAM RECEIVED in Philadelphia, Penn., announces the death of Henry Carvill Lewis, geologist, at Manchester, England, on Saturday, July 21. Professor Lewis was born in Philadelphia on Nov. 16, 1853. He was graduated at the University of Pennsylvania in 1873, and in 1879 joined the State Geological Survey as a volunteer, and first investigated the surface geology of southern Pennsylvania; after which he studied the glacial phenomena of the northern part of the State, and traced the great terminal moraine from New Jersey to the Ohio frontier. He furnished numerous papers on the geology and mineralogy of Pennsylvania to the Proceedings of the Philadelphia Academy of Natural Sciences. He was elected professor of mineralogy in the Academy of Natural Sciences in 1880, and to the chair of geology in Haverford College in 1883. These positions he held at the time of his death. Since 1885 he had been engaged in geological studies in Europe, working at microscopic petrology in the University of Heidelberg; and had completed a map of the separate ancient glaciers and ice-sheets of England, Wales, and Ireland. Professor Lewis was a member of a number of scientific societies in the United States and Europe, and contributed to their Proceedings and to other scientific periodicals, including the *American Naturalist*, of the mineralogical department of which he was for some time editor. It was at the British Association meeting held at Birmingham in September, 1886, that he read his first paper on 'The Genesis of the Diamond;' and in describing the peridotite of the De Beers mine, and that from Kentucky, he suggested interesting possibilities in regard to the latter locality. Since then he was actively engaged in the fuller preparation of his paper on 'The Genesis of the Diamond,' visiting all the localities in the Southern States where diamonds have been found; and it was undoubtedly his intention to read this paper at the coming meeting of the British Association in September, and then to continue his geological studies in Norway, remaining in Europe for three or four years. Professor Lewis was an indefatigable worker, of keen perception. Genial in his manner, he made many friends; and although he had not reached the prime of life, yet his work is known to the entire scientific world, and he gave promise of having entered upon a long life of usefulness. In him science has lost a valuable worker, and society a useful member, and he leaves a blank which will not be readily filled. He leaves a wife and one child.

IN SPITE OF THE USUAL vexatious delays, which often prevent the opening of new buildings at the appointed time, the new Marine Biological Laboratory at Wood's Holl, Mass., was formally

opened on the day appointed, Tuesday, July 17. The exercises were of the simplest and most informal character, as no programme had been arranged and no ceremonies were expected or desired. Nevertheless, several members of the Board of Trustees, a few students, and a half dozen or more of guests were present, and spent the morning in examining the new building and its equipment, and in visiting the laboratories and aquaria of the United States Fish Commission. At two o'clock the whole party dined at Gardiner Cottage, — the domestic headquarters of the new enterprise, — which a generous citizen of Wood's Holl, Mr. J. S. Fay, has kindly put at the disposal of the trustees. Shortly after three o'clock the Director, Dr. C. O. Whitman, delivered in the laboratory an opening address upon the history and functions of marine biological laboratories, referring especially to the Penikese School and to Professor Baird's labors in this direction. It is earnestly to be hoped that this address, which seemed to those who heard it unusually thoughtful and adequate, may be printed. Professor C. S. Minot then said a few words on behalf of the trustees, and the exercises were over. The trustees appear to have done wisely in deciding to make a beginning this year, for, notwithstanding the fact that the announcements were not made until most students and investigators had formed their plans for the summer, some eight or ten students are already at work in the laboratory. The responses from colleges and from students make it certain that another year will witness here a large and enthusiastic gathering of investigators and students in biology. The building appears to be admirably adapted to its purposes. It is plainly but strongly built, of wood, two stories high, and with a pitched roof. The roof and sides are covered with shingles, unpainted. There is a commodious and convenient basement under the western half of the building, intended for storage, for the safe keeping of alcohol, boats, oars, and the like. The lower floor of the laboratory is intended for beginners, and for teachers and students who are learners but not investigators. The upper story is for investigators only. The equipment includes work-tables, specially designed, and placed before the large and numerous windows. Each student is provided with a Leitz microscope, a set of re-agents, watch-glasses, dissecting pans, and the dishes and other things indispensable to good work. The laboratory owns boats, dredges, nets, and other tools for collecting. A small library has been provided, and, under the progressive and efficient management of Dr. C. O. Whitman and Mr. B. H. Van Vleck, a season that promises to be highly successful, and most important in the history of American biology, has been auspiciously begun.

THE NEW DEPARTMENT OF LABOR.

THE President's signature, July 11, of the legislative bill containing the appropriations for the new Department of Labor has completed the establishment of Col. Carroll D. Wright's bureau on a permanent and firm footing. The re-organization has, it is true, been more nominal than real. The force of men has not been increased, but a large number of clerks and experts who were formerly on the temporary roll have been transferred to the permanent one. The effect of this upon the character of the work they will do in the future is expected to be very beneficial. They have been trained for their work, but the uncertainty of their tenure of office — the danger that they might at any time have been dismissed by a failure of Congress to appropriate money for their salaries — has not encouraged them to work with that zeal that it is expected that they will manifest now that their permanent employment is provided for by the organic law of the Department of Labor. These remarks should not be construed as a criticism of the work of the temporary employees of the Bureau of Labor, for it is not open to such criticism, but to show the inevitable tendency and influence of uncertainty of tenure of office upon the work of any class of men, and the expected effect of permanency.

The scope of the work of the new Department of Labor is not much greater than that of the Bureau which it succeeds, but, under the new law, the Commissioner is directed to pursue certain lines of investigation which he pursued before only by authority of appropriations made from time to time, and which there was danger that some economically disposed Congress might now and then omit.

The Department of Labor is now engaged in making inquiries in three directions. The investigation to ascertain the economic, social, and moral condition of the working women of the leading cities of the country, which has been in progress for several months, is substantially completed, and its results will be set forth in the next annual report of the department to be presented to the President next December. The inquiry in regard to marriages and divorces is also substantially finished. This will be the subject of a special report, which will also be published about the time Congress meets next winter. A great amount of material bearing upon the condition of the railway employees of the country has already been accumulated in the department, and the work in this line of inquiry is progressing very rapidly, so that the report will be ready for the printer about next December.

This railroad inquiry has been pursued along two lines. The agents of the Department of Labor are gathering all the data to show the material and social condition of the railroad men of the country, their hours of labor, tours of duty, styles of living, beneficial organizations, etc. But Colonel Wright desires to embody in this report not only the rates of wages which are paid to these men, but also how much they actually earn in a year after all lost time has been deducted, and why the time is lost. The only way in which this information could be obtained was by an examination of the pay-rolls of the different railroads of the country. In most instances the railway officials have promptly and cheerfully responded to Colonel Wright's request by sending to Washington their pay-rolls for a year. Not one railroad company has refused to allow its pay-rolls to be examined, although some have preferred that the tabulations be made in their own offices. This report will be of especial interest in view of the frequent controversies between railroad managements and employees. It will show whether, as a whole, the railroad men of the country are required to work more or fewer hours than other workingmen, what their annual earnings are, and what is their social condition.

The inquiry provided for in the organic law of the Department of Labor in regard to "the cost of producing articles that are dutiable in the United States, in leading countries where such articles are produced, by fully specified units of production, and under a classification showing the different elements of cost, or approximate cost, of such articles of production, including the wages paid in such industries per day, week, month, or year, or by the piece; and hours employed per day; and the profits of the manufacturers and producers of such articles; and the comparative cost of living, and the kind of living," will be begun next fall, and the report will be ready for submission to the Fifty-first Congress at the opening of its first session. Statistics of this kind, in the honesty and impartiality of which representatives of both political parties had confidence, as they have in all statistics to which Colonel Wright puts his name, would have been of incalculable value in the tariff debate that is now in progress. Scores of members of Congress have applied at the Labor Bureau for just such figures as this inquiry will furnish.

Colonel Wright thinks that one of the most important provisions of the organic act of the Department of Labor is that in which he is "specially charged to investigate the causes of, and facts relating to, all controversies and disputes between employers and employees as they may occur, and which may tend to interfere with the welfare of the people of the different States." Experience has shown that it has been almost impossible, even for the sharpest newspaper reporters, to ascertain, when a great strike occurs, which side is in the right and which is in the wrong, or how far each is right and each wrong. The employers state their side of the dispute, concealing any thing that may be unfavorable to them, and the employees do the same. If the exact facts could be known to the public, popular sentiment would very soon decide which was right and which was wrong, and the latter would have to yield to this sentiment without much delay.

The Department of Labor has the machinery for gathering the

facts in regard to a great strike impartially, and publishing them within a few days, while the strike is still in progress. In very striking contrast with this are the ridiculous attempts of committees of Congress to investigate strikes. These inquiries, even if they begin when the strike is in progress, are never completed until long after it is over; and by the time reports are made, popular interest in the matter has entirely died out. Besides this, the testimony which a committee of Congress makes is jumbled together without any regard to order, and from this incongruous mass it is impossible for any one to get an intelligent idea of the facts.

Twenty-one of the States now have bureaus of labor statistics, and an effort is now making to bring about among them a uniformity of organization and methods of work, which shall also be in harmony with those of the national Department of Labor. When this is accomplished all of these bureaus will be able to coöperate with and supplement the work of each other, to the mutual benefit of all.

It is worthy of remark in closing that no European country, until recently, has had any system of gathering social statistics such as the Department of Labor is publishing from time to time. In most countries the authorities would hardly dare to institute such a system of inquiries, or, if they did, they would not dare to publish them. Belgium has lately established a bureau of statistics modelled after our Department of Labor, and a beginning has been made in England. That the scientific value of the work of the Department of Labor is also recognized in almost every foreign country is evidenced by the numerous letters that have been received from distinguished scientific men abroad, and by notices of its publications that have appeared in most of the scientific periodical publications of Europe.

THE BENDEGO METEORITE.

THE famous Bahia or Bendego meteorite described by Mornay and Wollaston in the Philosophical Transactions for 1816, and by Spix and Martius in their 'Travels in Brazil,' was landed in Rio de Janeiro on June 15, and is now in the collection of the Brazilian National Museum. The transportation of this great mass of iron, whose weight was variously estimated from six to nine tons, and which has been found to weigh 5,361 kilograms, was rendered possible by the recent completion of a line of railroad passing within one hundred and fifteen kilometres of the Bendego Creek, where it has lain since the unsuccessful attempt to remove it to Bahia in 1785.

As there was little prospect of a nearer approach by rail in the immediate future, the authorities of the National Museum attempted last year to stir up an interest in government and private circles for the removal of the meteorite to Rio de Janeiro. Almost immediately after the subject was broached, Chevalier José Carlos de Carvalho, an ex-naval officer who had some experience in the transportation of heavy masses of ordnance in the Paraguayan war, took up the idea with great enthusiasm, and proposed to the Sociedade de Geographia de Rio de Janeiro that the society should undertake the removal, offering at the same time to take charge gratuitously of the technical part of the operation. This proposition, which was heartily supported by the president of the society, Marquis Paranagua, was at once adopted, and a committee, with Mr. Carvalho at the head, was appointed to raise the necessary means by a popular subscription. This work proved unexpectedly easy, as a prominent and wealthy member of the society, Baron Guahy, offered, as soon as the matter was mentioned to him, to defray all the expenses. The project was also warmly espoused by the Princess Regent, and by the Minister of Agriculture, Counsellor Rodrigo Silva; and everything depending on the government, such as transportation, material from the arsenal and railroad shops at Bahia, etc., was placed at the disposition of Mr. Carvalho, and two government engineers, Drs. Vicente de Carvalho and Humberto Anuores, were detailed to aid in the undertaking.

After about three months spent in preparing material and in studying the route to be traversed, the march commenced on the 25th of November, 1887, and the meteorite was placed on the railroad on the 14th of May of the present year. A road had to be opened for this special purpose, as those existing in the region are only mule paths: over one hundred streams, one with a width of eighty metres, had to be crossed by temporary bridges. The route lay over several chains of hills and one mountain range, in which an ascent of 265 metres had to be overcome with a grade of 32 per cent. In overcoming these many and serious obstacles Mr. Carvalho and his companions gave a brilliant and practical rebuttal to the somewhat widespread, but unjust, notion among foreigners that the Brazilian character is deficient in the qualities of ingenuity, energy, and perseverance; while on the other hand the generous donation of Baron Guahy, amounting to about ten thousand dollars, proves that wealthy and public-spirited Brazilians can be counted on for pecuniary aid for scientific purposes when once the matter is properly brought to their attention.

Important aid was also rendered to the enterprise by Drs. Luiz da Rocha Dias and José Ayrosa Galvao, chief engineer and first assistant of the government railroad line in Bahia; by Richard Tiplady, Esq., superintendent of the Bahia and San Francisco Railroad; and by the firm of Claudio de Vicenzi & Co., owners of the steamship Arlindo, on which the meteorite was given free transportation from Bahia to Rio de Janeiro.

THE HEMENWAY-CUSHING EXPEDITION.

MR. FRANK H. CUSHING, whose wonderful discoveries in regard to the customs and religion of the Zuñi Indians, made during his residence among this remarkable people, are recognized as the most valuable of recent additions to American ethnologic knowledge, has spent the past winter and spring, as may be known to many readers of *Science*, in Arizona, making explorations of extensive ancient ruins there. The expenses of this expedition, which is well equipped, are paid by Mrs. Hemenway of Boston, the lady who has lately shown such substantial interest in Mr. Cushing's work. That gentleman had reached a point in his studies of the Zuñis that, in order to pursue them further, it seemed necessary to attempt to trace their history back to the beginning by an examination of the ruined cities and temples in which their ancestors lived and worshipped. This is the object of Mr. Cushing's recent work. Attached to this expedition, during the past winter and spring, was Dr. James L. Wortman, of the Army Medical Museum, who has recently returned to Washington. His mission was chiefly that of an anatomist engaged in anthropological work. The Medical Museum has been engaged for several years in the collection of human skeletons for the purposes of comparison, and the net result of Dr. Wortman's labors during the past winter and spring has been the securing of about one hundred complete skeletons, the skulls of which are in a good state of preservation, although the rest of the bones are more or less imperfect.

In an interview since his return Dr. Wortman has given the first account of Mr. Cushing's latest work that has been published, and from a report of this interview the following brief description of the explorations of the expedition and their results has been made up.

The scene of Mr. Cushing's explorations is the wide valley or plain at the confluence of the Salt and Gila Rivers in south-western Arizona. To-day railroads cross this valley, and much of it has been reclaimed by irrigation from the desert condition into which it relapsed when the ancient inhabitants disappeared. Still a wide expanse of the plain, which is forty-five miles across, remains a desert covered with sage-brush, cactus, and mesquite. It slopes from the Salt to the Gila River, and advantage was taken of this feature of its topography by the ancient people in constructing canals to irrigate the whole plain. In some places these old canals have been re-opened by the modern farmers, and restored to their original use. On this wide plain are many groups of mounds, in excavating which Mr. Cushing has discovered many ancient cities, to some of which he has given the names of Los Muertos, Los Hornos, Los Guanacas, Los Pueblitas, Los Acequias, etc. Los Muertos, the city of the dead, has been traced for three or four miles, and forty or fifty huge structures or communal houses in it have been examined.

The surface indications of these cities are a series of truncated mounds twenty or twenty-five feet high, surrounded by a great number of fragments of ancient pottery. The cities consist of irregular groups of houses built along the banks of the canals.

In the ruins of these structures, Dr. Wortman says, the greater part of the specimens have been found. The houses are rather large, 300 or 400 feet long and 200 feet wide, possibly larger. They were generally built of adobe bricks, sun dried, without straw or admixture of cement of any kind. In some instances, Mr. Cushing thinks, they were four or five stories high, but this can only be conjectured from the size of the mounds, the thickness of the walls, and the quantity of the *débris*. All that now remain are the foundation walls, and around and within them the *débris*. These houses seem to have been constructed on the same plan as the pueblos of the Zuñis, the Moquis, and other existing pueblos. In Casa Grande a cement is found to have been used on the outside ând inside of the structure. The builders were probably acquainted, as the Aztecs were, with some sort of cement, which they used to protect their structures from the weather. In some instances it was found that, instead of building with adobe bricks, upright posts had been set up. The space between was wattled with cane or willow, and then filled with adobe. The woodwork has entirely disappeared, there being nothing left of it except occasional bits of charred wood. The post holes are still there, and show the manner of construction.

The dead were buried in the houses. Below the floor of the house a vault was dug, and the body, first wrapped in cloths of some description, was deposited in this sepulchre. Then the grave was filled with adobe, which was packed around the body. Food-vessels and water-jars were also buried with the dead. With the body of a man of consequence, war-clubs, images of various kinds, arrows, and other articles were also interred, but, of course, only the most imperishable remain. Sometimes two or three bodies have been found in the same sepulchre, and it is believed that where two are found in one grave they were man and wife. The skeletons are not well preserved, and crumble after a few hours' exposure to the air. The bodies were wrapped in cotton cloths, as is shown by the impressions left in the adobe, or mud, which was soft when it was first packed around them. In some instances the fragments of cloth have been found. It is of rather fine texture' and the size of the cavities in which the skeletons are now found proves that the bodies must have been wrapped thickly, so that little or no moisture had access to them. Such being the case, the condition of the bones, especially when the dryness of the climate of Arizona is considered, indicates a great antiquity for these burial places.

The tombs already described appear to have been those of the priestly class. The bodies of the common people were cremated. In connection with each house supposed by Mr. Cushing to be the house of a clan or one of the sociological divisions, such as are found among the Pueblo Indians, was what the explorer calls a pyral mound. On this the bodies and effects of the dead were consigned to fire. This mound is eight or ten feet high, and is composed entirely of the accumulations or *débris* resulting from these cremations. The ashes and charred bones of each body were collected and placed in an urn, which was buried at the foot of the mound from six inches to a foot below the surface. In some instances as many as 400 or 500 of these urns were found buried about a mound.

Between forty and fifty of the large, or communal, houses were found in Los Muertos. In the centre was a structure larger than the others, which Mr. Cushing called a temple. In this building, which was enclosed by a strong adobe wall, and in no other, were bodies found deposited in an upper story. Here there were four or five adobe sarcophagi, two of which were placed nearer the centre of the building than the others, were more conspicuous, and contained what appeared from the skeletons to be the remains of men of advanced age. Mr. Cushing said that extra decorations were found on these two sarcophagi. It is supposed that this was the home of the chief ruler of the tribe, the chief priest, or some one of exceptional note. The object of the wall surrounding the structure was probably to make it a stronghold or citadel in time of war. The temple might also have served as a general storehouse for provisions.

Other structures of a peculiar character were discovered. They were circular, and in the centre of each was a fireplace. One of these was found in each city. Mr. Cushing thought that this round structure was a temple of the sun, or something of that sort, as nothing was found in them but the fireplace and broken pottery. The one most carefully excavated was forty or fifty feet in diameter.

This ancient people built all their houses on the main line of the irrigating canal. This irrigating system was extensive. The many ditches and canals were constructed on a peculiar plan. A cross-section shows a series of terraces. At the bottom is a central ditch, and above this, widening to the top, are terraces. The large canals are about twenty-five feet wide at the top, the central ditch being four or five feet wide. Mr. Cushing believes the canals were used not only for irrigation, but for navigation as well. "We know," said Dr. Wortman, "that the inhabitants of these towns used timbers of considerable size in their building operations. The only available wood in the immediate vicinity was cottonwood or mesquite, which would not serve their purpose. They used pine, and the nearest point where they could get lumber of that description from was seventy-five or a hundred miles away. Timbers of a size required by them in the construction of their buildings could not be carried such a distance on the backs of men. The conclusion is that they floated them down the Gila or Salt River. Certain remains have been found indicating that they constructed of reeds rafts, or balsas, such as are found in Mexico and the South Sea Islands. Stones of considerable size, not found on the plains, were taken to the towns from the mountains. It would have been impracticable to have carried these stones such a distance unless they were floated on rafts.

"To conduct water from one level to another in these canals was a gigantic undertaking, especially when the character of the implements used is considered. They had no tools except stone ones in making their excavations. A few copper implements were found, but metal was scarce. Copper was used for ornaments, earrings, and bells. There was not enough, it is supposed, to use for agricultural implements. The irrigating system is sufficient in extent to render the whole extensive valley fertile. The beds of the canals were puddled. Soft mud was packed down well, and then burned or baked by filling the canal with brush and setting fire to it. When constructed this way the lining was almost as hard and impervious to water as terra-cotta pipes. They lost but little water, and the people were extremely economical of water. In some places large ditches terminated in great reservoirs. In these probably water was stored to be used in times of drought. The longest irrigating ditch was probably about twenty-five miles long. The river has perceptibly gone down in its bed since water was taken from it to fill these canals."

The theory that these towns were occupied successively is disproved, Dr. Wortman thinks, by the fact that some towns are twenty-five miles from the river, and all the intervening space is covered with ruins. Canals were constructed from the river to the furthermost town. If the towns were successively occupied there would have been no necessity for constructing these irrigating canals. The enormous labor expended with stone picks for excavating and baskets for carrying away dirt in extending these irrigating ditches to these distant points indicates plainly that all the land between them and the river was occupied.

Mr. Cushing's party found on the rocks of neighboring mountains petrographs, or crude etchings. All illustrated matters of a realistic nature, and did not record the history of an individual or of a nation. They represented men offering prayers for rain, or herders or hunters offering sacrifices. These rock pictures are interesting, however, as bearing upon the question of the use of domestic animals by these people, and their probable acquaintance with the use of wool. In these petrographs appear representations of animals much like the llama of South America. They are represented in a position or attitude that the llama habitually assumes. They are so pictured as to lead to the conclusion that they were domestic animals. They are connected with a string or cord, a man having hold of the string and appearing to be driving them.

Mr. Cushing has also found in the ruins a number of terra cotta figures, representing various animals that were hunted, — the mountain sheep, the deer, the fox, the coyote. In one case a number of figures of animals corresponding in appearance with those pictured were found buried together. Mr. Cushing came to the conclusion

that these were a herder's sacrifice. Instead of sacrificing the animals themselves he substituted the images. The animal represented undoubtedly resembles the llama. It is quite different from the mountain sheep or any other animal corresponding in size, and has a long neck. If it is true that they possessed a domestic animal of this species, either the people were of very great antiquity or there was a species of llama in North America at a much more recent date than scientific men suppose. It is a matter, too, of extraordinary interest and significance, if these people had the same domestic animal as that found among the Peruvians when the Spaniards first came to this country. If they had such a domestic animal they undoubtedly took its fleece for clothing, and had woollen as well as cotton fabrics. Some of the earlier Spanish explorers speak of woollen cloth in the possession of the Pueblo Indians. If there is truth in that, then it is more than probable that these people possessed a domestic animal of the llama species probably as large as a good-size sheep.

These people had access to the Gulf of California. This is proved by the discovery of shells in the ruins which have been identified as belonging to the Pacific coast. Though at a considerable distance, they probably had communication with the seacoast and obtained shells by bartering with other Indians. Of some of these shells skilfully carved ornaments are made. Mr. Cushing found a frog carved from a shell, the back being inlaid with turquoise. The inlaying had been done by cutting little square holes in the shell and fitting pieces of turquoise to them. A native species of lac was used in cementing the pieces. This lac was used also in basket-work. They made carved bracelets, earrings, and finger rings, and various ornaments inlaid in the manner described.

The petrographs did not throw much light on the manner of dress that prevailed, as they showed only the costume worn at certain ceremonials, — a long gown extending down almost to the feet. Near the skeleton of an old war-chief was found a fragment of a gown that must have been richly embroidered in various colors. It was badly decayed, but there was enough left to show that it was an embroided garment.

"The antiquity of these ruins is not settled," said Dr. Wortman. "It has been maintained by respectable authorities that these ruins were occupied within the historic period. I don't think that can be possible. Historic evidence is decidedly against it. We have some records of the earliest Spanish explorers bearing on that point." Dr. Wortman stopped here briefly to summarize the history of the explorations of Cabesa de Vaca, prior to 1530, and of his immediate successors, Father Nisa and Coronado. Coronado's route, he said, to Casa Grande could be easily traced. There he found the ruin now standing, and gave a description of it by which it could be recognized to-day. "If it be true," said the doctor, "that Casa Grande, or Chichillecato, the Red House, a ruin still standing three stories high, twenty-five or thirty miles from Los Muertos, was in ruins when the Spaniards came there, as the records of Coronado's expedition in 1540 plainly indicate, assuredly these houses that Mr. Cushing is excavating, now practically levelled to the ground, had disappeared long prior to that period. In all the excavations Mr. Cushing has made, in the thousands of specimens collected, not a single specimen has been found that would give evidence of contact with whites. My own opinion is that the ruins are pre-Columbian, and if I were going to give a guess I would say they are not less than a thousand years old. The size of the mesquite trees growing from the mounds, indicates a great age."

"Considering all the evidence," said Dr. Wortman, "I have no doubt that when these ruined towns were inhabited, this valley, many miles in extent, was a fertile region, occupied by a thrifty people. They raised cotton, corn, and tobacco. Fragments of cotton have been dug up, tobacco has been found in their sacred cigarettes, and charred corn-cobs also remain to give evidence as to the agricultural products of the valley. As to the population, allowing even a greater number of acres to the man than is now cultivated by the Pima Indians, who, besides supplying their own wants, raise a large quantity of wheat to sell, allowing, say from five to eight acres to a man, the population of the valley must have been at least 200,000, if, as I believe, all their towns were simultaneously occupied. There are evidences that the Zuñis of to-day are a remnant of these people.

The osteology of the people has not yet been thoroughly studied. The skeletons collected will be compared here at the Medical Museum, and the careful study of them will undoubtedly throw much light on the relations of these people to historic people. The heads were short, or, in other words, the people were brachy-cephalic. They were small in stature. The general indications are that they are related to the Zuñis, and they are not unlike the Aztecs and Peruvians. Among the skulls I have found frequently the Inca bone or *Os Inca*, the extra bone in the back part of the skull, which received its name because it was a common thing among the Incas. These indications, with other evidences, suggest many interesting inquiries. It may have been that from this ancient civilization sprang that of Central America and of the Peruvians. A portion of the people may have migrated south, taking the llama with them, while others went north and founded the later Pueblo civilizations."

THE IMPARTIAL STUDY OF POLITICS.

SINCE Burke vindicated in such a memorable manner the party-system in politics, it has taken an extension which probably he never dreamed of. It is a curious speculation what estimate he would have formed of those larger developments of his principle which the nineteenth century has witnessed; for, indeed, there is a great distance between his cautious assertion that 'no men can act with effect who do not act in concert,' and some modern applications of the doctrine of concerted action. We cannot prevent or avoid parties. But let us, at least, be alive to the dangers that attend them. They act upon our habits of thought. They accustom us to consider public questions in a spirit as unfavorable as possible to the discovery of truth. They produce a kind of epidemic lunacy, such as history sometimes exhibits to us in nations that are on the eve of great disasters.

Some efforts have lately been made in England, similar to those now making in this country, to which we referred last week, to grapple with the specific evil of this mental disease produced by party spirit. These efforts have chiefly proceeded from the universities, and have been more or less connected with the movement of university extension. The Social and Political Educational League lately held a meeting, to which Prof. J. R. Seeley communicated an address he had delivered two years ago to a similar society, the Cardiff Association for the Impartial Study of Political Questions. This address we reproduce from the *Contemporary Review*. It was made to an English audience, but has much in it to make clear the problem to those of us in America who are interested in the scientific study of political questions.

The impartial study of political questions! If political questions — that is, questions of the public well-being — are all-important, if an interest in them is among Englishmen universal, it might seem scarcely necessary for you to found a society, or for me to deliver an address, in behalf of the impartial study of them. For surely all honest, serious study tries at least to be impartial. Surely there can be no more obvious cause of error than partiality. The judge, when he addresses the jury, warns them against yielding to bias or prejudice; the scientific man, in his researches, is especially on his guard against that tendency to a foregone conclusion which spoils all investigation and reduces it to a mockery. Surely there can be no exception to the rule that study should be impartial: surely there cannot be subjects in the study of which partiality is to be recommended or not to be condemned.

Yet somehow this undertaking of yours, that you will study political questions impartially, sounds strange and startling, and you seem to feel it so yourselves. Perhaps what is strange is that politics should be regarded and spoken of as a matter of study at all. Yes. Let us frankly admit that we may naturally be a little startled, a little alarmed, to hear politics classed off-hand, as we might class arithmetic or geography, among subjects of study. Politics concern our greatest interests, and therefore excite our warmest feelings; not among studies, not among sciences, we class them more naturally among higher things, by the side of religion, honor, morality. To be a politician is to be warm, eager,

earnest, devoted: the virtue of a politician is to be staunch and zealous in the cause he attaches himself to; and that sort of cold indifference which seems implied in impartiality appears not only not a duty, but actually a sin, in politics.

You do not mean, I am sure, when you undertake to be impartial, that you will for the future cease to be earnest and eager politicians; that you will renounce all strong, clear, sharply cut opinions; or even that you will for the future regard the strife of political parties with indifference, as if it no longer concerned you, much less with contempt, as if you were raised above it. And yet how can this be? How can you be impartial and partial at the same time? How can you at once maintain the passionless objectivity that befits the student, and the ardor, the unflinching decision, without which a politician is good for nothing?

There is no real difficulty here, and yet there is so much apparent difficulty that it is worth while to dwell for a moment upon the point. By partiality we do not mean strong and decided opinions. Of course, when you hear very unsparing and rancorous language used, very uncompromising courses recommended, you may suppose that you are among strong partisans; that is, partial people. But it is not necessarily the case. Opinions formed with perfect impartiality may be strong and uncompromising. The strongest opinions are often the most impartial, even when such opinions are most strongly and passionately expressed. I was surprised, the other day, to hear a friend say of M. Taine's book on the French Revolution that it was evidently partial. He said so because M. Taine has taken a very unfavorable view of the Jacobin party, and has spoken of them in very unsparing language. But does this, by itself, prove him to be partial? If so, what are we to do when we have to deal with great crimes and great criminals? Are we not to describe them as they are? Partiality means a deviation from the truth. When, then, the truth is extreme, terrible, monstrous, — and this is sometimes the case, — partiality would be shown, not by strong, but by weak language. If the Jacobins really were the monsters M. Taine believes them to have been, it was impartiality, not partiality, to describe them as he has done. Everything depends on the fact, on the evidence. Now my friend put the question of fact entirely on one side. He inferred the partiality of M. Taine immediately from the warmth of his language. What struck me was that he did not profess to have examined the evidence and found the charges brought against the Jacobins groundless. He only argued: The picture is extreme, therefore it must be partial. M. Taine writes with strong indignation, therefore we are not to trust him.

Now, I say, indignation, strong feeling, is not necessarily partiality, and therefore strong language is no proof of partiality. Partiality is the sacrifice of truth to a party. In order, therefore, to convict a writer of partiality, you must show that he was connected with a party at the time when he made his investigation, and that this has prevented him from discerning the facts or estimating them accurately. And yet M. Taine tells us that when he formed his estimate of the French Revolution he had no party connection. All the passion he now shows has been aroused in him, so he says, by the study of the facts, and therefore it cannot have prevented him from studying them properly. Nor does it now prevent him from seeing them; on the contrary, he feels it precisely because he sees them so clearly. Of course, my friend had a perfect right to arrive at a different conclusion. But, even supposing M. Taine to have made a great mistake about the Jacobin party, he would not, I think, be fairly chargeable with partiality. For partiality does not merely mean error or exaggeration; it means specifically that kind of error or exaggeration which is produced by judging of things under a fixed prejudice, under a party bias.

This, at any rate, is what you mean when you undertake to study politics impartially. You mean merely that you will consider the facts without bias. You do not undertake that when you have considered them, no strong feeling or passion shall arise in your mind. You will not begin your studies with a political bias, but you do not undertake that your studies shall not give you a strong political bias. Nay, your object is to acquire a firm political creed. And what reason is there to think that this creed, when you have found it, will not be as sharply cut and positive as those old party creeds which you refuse to regard as authoritative? There is nothing in the impartiality you aim at which is inconsistent with the strongest feeling or the most decisive action.

In a country like this, where party passion has been so much indulged and has burned so hotly, the opinion, the political creed, of most people has been imposed upon them like the religion in which they were born. They have lived in it as an atmosphere of which they were scarcely conscious; or, if they have become aware that questions have another side, that opinions different from their own are tenable and even plausible, they have soon found that it was not so easy for them to change their atmosphere; that they broke ties, disappointed hopes, suffered inconvenience, perhaps incurred serious loss, when they tried to establish an independent political position for themselves. You do not, I suppose, complain of this. You recognize that political activity imposes a certain amount of restraint upon individual opinion. I, for my part, should go as far as most people in admitting that there must be compromise, that there must be party-subordination, that we must sometimes waive a conviction, sometimes stifle a misgiving. Practical life has exigencies which the theorist is slow to admit. It would be so delightful if we could always act simply in accordance with our convictions. But, alas! it happens sometimes — nay, my historical studies lead me to think it most commonly happens — that men have to act on the spur of the moment, and must act with decision, when they are tolerably well aware that they have no solid opinion. Through the greater part of history, it seems to me, political action has been a leap in the dark. And yet the leap had to be taken. The problem has generally been, not, What is it right to do? but, Granted we do not know what is right, yet since we must do something, what will it be safest on the whole for us to do? In such circumstances the best course of action is but a make-shift, and a rude organization is prepared to regulate it. We select a leader in whom we hope we may confide, we rally round him and surrender our opinions to his. He shapes for us a creed to which we resolve to adhere, and which we try to regard as true enough for practical purposes. And then it becomes a virtue to be loyal to our party, and soon to be too nice about the party-creed, to indulge in independent thought or in impartiality, — all this begins to seem unpractical, perverse, fatal to party discipline, tending to confusion. Is not this unavoidable? Must we not make the best of it?

But now when such party-discipline is maintained for several generations together, the alloy of falsehood that was there from the beginning accumulates, until the quantity of it becomes prodigious. In the end, the heady, drugged liquor that we drink mounts to the brain; the fog of falsehood that settles over us, fed continually by speeches in Parliament, speeches at the hustings, speeches and leading articles everywhere, begins to blot out the very heavens, till we stagger, blinded and choking, in an atmosphere composed of the lies of many generations, which lie in layers one above another, where no breath of fresh thought has been suffered to disturb them. It is then that we begin, if we are wise, to say to each other, 'Come and let us make an impartial study of political questions.'

Surely such a crisis has now come upon us. The portentous disruption that we have just witnessed must surely give rise to a certain amount of political scepticism, must lead us to revise our method, and look with some little suspicion into the logic by which we have been in the habit of ascertaining political truth. Misgivings were hushed in the triumphant years when Liberalism marched from victory to victory. An observer, indeed, might find it hard to grasp the theory of the thing. By what process a new crop of liberal doctrines always sprang up when Liberalism seemed exhausted by success, how the new doctrines were so easily proved to be truly liberal even when they appeared inconsistent with the old, whether there was any limit to the power of developing new doctrines, similar to that which Father Newman attributed to the Catholic Church, with which Liberalism was credited, — these and a hundred other doubts occurred to the observer, but the party was not troubled by them. For why? The party was successful. The prodigious agreement and enthusiasm with which each new discovery was welcomed, the prodigious success which attended each new development, seemed like signs of a divine inspiration, and Liberalism, like Catholicism, — from which indeed it borrowed much, — overwhelmed opposition by an appearance of

unanimity, universality, and certainty. But this dream of unanimity is now surely dissolved. Under the name of Liberalism we see now what different, hostile views were confused together. The Utopia of a world governed by a consensus among all rational civilized people, where force would be scarcely needed except to control a few obstinately perverse representatives of the older state of things, surely this is gone. And if so, all the difficulty, all the bewilderment, comes back upon us. We must seek some other note of truth, now that the old Catholic one, — *quod semper, quod ubique, quod ab omnibus,* — in its modern paraphrase, the agreement of the civilized world, has failed us. What can we do then? What else in political questions but what we do in questions of another kind? If we would know the truth about a subject, we study it. If, then, we would know the truth about politics, let us devote ourselves to the impartial study of political questions.

For, after all, politics may be looked at in another, in quite a different way. Instead of an arena of contest, in which Tories, Whigs, and Radicals are marshalled against each other, in which the same old watchwords are eternally repeated, the same reckless popular arguments continually furbished up anew, — an arena, in short, of action and adventure, — we may speak of politics as a department of study, if not of science. We may talk of political science, or political philosophy. There is no difference of opinion about this. All parties have what they call their principles, profess to assert certain political truths, refer to great writers who are supposed to have established the doctrines which it is their business to reduce to practice. These principles, these doctrines, must clearly be matter of study. If they are erroneous, the party that founds on them must needs go wrong; so too if they have been misconceived or misapplied. How is it, then, that we hear so little of politics as a matter of study? How is it that they are not taught in schools or at universities?

Well, this is the way of the world. It is the fate of all great doctrines which have momentous practical applications to be lost in their applications, to fall into the hands of practical men who troubled themselves but little about their abstract truth, and think exclusively of making them prevail, and themselves prevail with them. Of the immense crowd that in a country like this take part in politics, only an individual here and there has any taste for the theoretic side of them. To the majority the principles are mere solemn platitudes which give dignity and respectability to the pursuit. For them the real business begins when the personal element enters, when elections take place, when A wins and B loses; or when an institution is attacked and a grand fray takes place, exciting all the emotions of battle and ending in a distribution of spoils. Not that they could do without the principles. No; half the pleasure of the fray consists in the proud sense of fighting for something great and high. They like immensely to feel themselves champions of the truth, crusaders. But their own business is with the fighting; the principles they take more or less on trust. Some one else, no doubt, has inquired and philosophized; they are content with the results. A grand war-cry is the main thing; this, and a short argument to save appearances, will suffice for the theoretical part. And so they plunge into the fray, not suspecting that in many cases the measure they support does not really embody the principle they profess, that sometimes the so-called principle is a mere ambiguity which sounds so grand just because it is hollow, and that sometimes when it is most solemn and most impressive it is nevertheless entirely untrue.

I wish people could understand that it is not enough to have principles, — they must have true principles. We talk sometimes as if principles were grand things in themselves: we admire great historical struggles, on the ground that it is a proof of a noble energy when people are found ready to make sacrifices for principle. Better, no doubt, is energy than mere stagnant indifference; but I often think we forget, or do not sufficiently consider, how great is the instinctive, almost automatic love of fighting in the human animal. Sacrifices for principle! Well, but was the principle true? Did the combatant, before he entered the fray, ponder conscientiously, methodically, the principle on which he acted? Did he impartially consider the question? For if not, and this is the commoner case, the struggle, war, or revolution was not really for principle: it was only an outbreak of the combativeness which is our besetting sin, and principle was not really the motive of it, but only the pretext. History is full of these sham wars of principle, of which the main result is to bring the principle itself into discredit. In religion and in politics the noblest doctrines gradually lose their sacredness through being turned into the war-cries of hypocritical parties, — parties which professed to have been moved by these principles to take up arms, when in fact they took up arms for the fun of it, and then sheltered themselves under the principle.

No one has any right to talk of principles, either in politics or any other great subject, who has not made a methodical study of the subject. Principles of this sort do not come to us by inspiration. At this time in the world's history, when on every subject such stores of information have been collected, when method has been so carefully considered, and so many false methods have been exposed and renounced, we must cease to confound principles with party cries, or to imagine that any high-flown sentiment or jingling phrase is true enough to fight for or good enough to hold a party together. We must be serious. In other departments we have long been impatient of hollow phrases. In scientific investigation, for instance, the phrase, the swelling oracular maxim, is utterly discredited; it is scouted as mediæval, as belonging to an obsolete system. Principles of quite a different sort reign now in that department, — principles slowly arrived at, provisionally admitted, until a prodigious weight of experience confirms them, and if accepted at last, liable even then to disappear in further developments and higher generalizations. But it is still quite otherwise in the political world. There it seems that no corresponding advance has been made. There the old watchwords still reign; there the old, vague, blustering terms — liberty, equality, and the rest of them — and the old maxims, traditional commonplaces of party rhetoric, live on in a world where all else is changed. Surely, in these days we want words less pompous and more carefully defined, principles better tested and better suited to the modes of thinking of the age.

I do not know but that you may be disposed to regard me as something of a sceptic in politics. Not so, if it is scepticism to doubt whether truth in politics can possibly be attained, for I have more belief than most people in the possibility of giving precision and certainty to our knowledge in this department. But I am a great sceptic about the current political system. For, in the midst of all our party divisions, there has grown up a sort of accepted political creed, a doctrine which is held to be almost beyond controversy, the settled result of civilization and progress. It is supposed that all enlightened men are agreed upon this doctrine, and that by it all the principal questions of government are settled, so that really not much now remains open to question. I am indeed a great sceptic about this supposed creed of civilization. I believe it will not bear examination, and that scarcely any article in it is final. I believe that of those principles upon which all enlightened men are suposed to be agreed, many are not even true. That imposing semblance of a final agreement, in which before long all controversy will be merged, appears to me a complete illusion, an illusion of a very ordinary kind. The appearance of agreement is only the result of vagueness in the use of language; the fabric looks solid only because we are not allowed to come very near it; the propositions sound satisfactory only because they have never yet been analyzed.

How, indeed, *can* this system be true? Where, how, and by whom was it framed? It did not grow out of an impartial study of political questions. It sprang up in the midst of party controversy, in minds heated with opposition and contending for interests. Party conflict may be necessary, and for certain purposes good, but it is not a school for the discovery of truth. To discover truth requires impartiality first; next, contempt for mere popular success; then continuous, patient, often difficult trains of reasoning. All these are necessarily wanting in the party-strife, where votes must be obtained at whatever cost, and where it is vain to urge any thing, however essential to the demonstration, which is not popular, immediately intelligible, obvious to the meanest capacity. In those conflicts truth may be propagated, when it has been discovered by other means; but it can be neither discovered nor proved, and the most splendid triumph at the polling-booths leaves the question of truth precisely where it was. We could imagine a great and final system

of political truth springing up among us, if it were the work of political philosophers improving their methods and concentrating their efforts as philosophers have done in other departments, but it is not represented as having sprung up mainly in this way. By great party-conflicts, by acts of Parliament, which have settled great questions practically for us, it is supposed that in some way truth has been discovered or at least proved, as if the ballot-box could be an organ of scientific discovery. Though I use so many words, I do but say perhaps a little more strongly and decidedly what you affirm by the act of founding this society. You say we should study political questions impartially. I say we must put politics on a new basis, — on a basis of systematic and reasoned truth. We must have, not Whig and Tory principles, handed down to us from the party-conflicts of other times and enshrined in the rhetoric of ancient party-leaders, but principles of political science as taught by great thinkers and writers. Those great writers, whom we name with reverence, yet scarcely read, and seldom practically follow in our politics, must come now to the front, must take henceforth the lead. We must have masters whose style is calm, whose terms are precise, whose statements are duly qualified, who see both sides of a question, and who know the history of the past, — the Tocquevilles and the Mills, — and we must make up our minds that if any thing like agreement is ever to be reached on political subjects, it will not be by any amount of party agitation, or by any number of victories at the poll, but by a sufficient supply of such teachers, and by due docility in those who learn from them.

In other words, politics must become a branch of study, a matter of teaching and learning. But here, perhaps, I may seem to expect too much, and you may doubt whether your society can attempt a study which I represent as so scientific. You begin well by securing help from all the political parties. This, of course, is indispensable; and if you make due progress, the time will come when at your meetings you will have become so accustomed and so attached to the free scientific way of handling the subject, that you will almost forget the existence of those parties. I think you are right too, if, as I hear, you have decided not to proceed to a division at the termination of a debate. I like this, and think it is perhaps more important than some might suppose. Your object is to find the truth. Now a majority may be a very respectable thing, but it has no function in the investigation of truth. This is perhaps hardly a truism, if I may judge from the prevalent way of speaking. How often is some great act of Parliament, some reform bill, spoken of as if it had established a principle, as if in some marvellous way it had made something true and right which was not so before. But in the pursuit of truth the number of votes is of no sort of importance. It is so wholly indifferent which side has the majority that you can infer nothing whatever from it. A majority has, it seems to me, no particular inclination to take the right side, but also it has no particular leaning towards the wrong. It belongs to political action, and has no place in political study.

So far, then, it appears that you have made excellent arrangements for a political debating society. But allow me, first, to warn you against resting content with a mere debating society; and, secondly, to suggest the possibility that your present plan may not prove sufficient to meet all your wishes, and may call for additions and further developments.

First, a debating society, whether impartial or not, is still a society simply for making speeches. In the debating societies that I have known, speech-making has been an end and not merely a means, — nay, it has been almost the principal end. The main object which the members have had in view has been to acquire the power of expressing themselves in public with freedom and effect. No doubt, in any good debating society, the matter as well as the form of the speeches is considered; but distinctive excellence will appear chiefly in the form. Now what is it that you mean to encourage, just thinking on political subjects, or merely smart speaking? Do we want a new society for the purpose of training a few more of those talking-machines of which we have so many already, of encouraging that fluency in political platitudes which our party system itself encourages too fatally? I have assumed throughout this address that your object is precisely opposite, that you wish to acquire a firm grasp of principles, to lay a foundation of political knowledge in precise definition, luminous classification, trustworthy generalization, authentic information. This you hope to do by the co-operative method, by a society, by meetings. I would ask you to consider carefully the regulations which will determine the character of your debates. Bear in mind that clearness of thought has one eternal enemy, — rhetoric. It is difficult to encourage eloquence and to encourage justness of thought at the same time and by the same methods. Your regulations ought to put some restraint upon the flow of rhetoric, to reduce as much as possible the temptations to display. Perhaps, for example, if you have some meetings where the audience is large, you might arrange to have other meetings smaller and more select. You might try to introduce dialectical discussion, which should proceed by rapid question and answer, objection and reply, and where the members should speak sitting. As your object is to assimilate political as much as possible to scientific discussion, you should study to borrow the forms of scientific discussion. Parliamentary forms, I think, should be avoided. Written papers should be encouraged, since writing almost imposes serious reflexion. It will be of no avail to eschew partiality, if you allow yourselves to fall into the snare of rhetoric. Tinsel phrases, the childish delight in uttering solemn periods and hearing the sound of applause, bias the mind not less powerfully than party connection.

Another difficulty occurs to me. You intend to discuss political questions. But is it so easy to decide what questions are political and what are not? Is it so easy to fix the limits of the political sphere? That question becomes urgent as soon as you begin to regard the subject seriously. Of course, if you are contented with delivering a series of set speeches which shall be greeted with applause, or if you intend merely to repeat the old story how the Whigs or the Tories have been always right and their opponents always wrong, the difficulty will not trouble you. But if you really entertain the notion of discovering truth, if you intend to investigate political questions seriously and renouncing all foregone conclusions, you cannot but soon make the remark how difficult it is to separate political questions from others which are not usually called political. If there is a science of politics at all, it must needs be almost the most complicated of all sciences. It deals with that curious phenomenon called the State, which is a kind of organism composed of human beings. The lives of individual men, even the greatest men, are included in the life of the State: almost everything indeed is included in it. Does not the very thought of studying such a vast comprehensive phenomenon, and of discovering the laws that govern it, give rise to a feeling of bewilderment? Does it not strike you that this study must rest upon other studies, that this science must presume the results of other sciences, and therefore that it cannot properly be studied by itself? Let me illustrate this by one or two examples. I will take almost at hazard some of the questions which are most likely to occupy you. I see on your list the question of free and fair trade. You will not doubt that this question is political: it is proved to be so by the plainest of all tests, for it decides votes at the hustings. But it is equally evident that the question belongs to political economy. The freedom of trade has formed the main topic of economists since the 'Wealth of Nations' was published. Here then politics run into political economy. If you seriously mean to form an opinion on this political question, how can you evade the economical question that lies under it?

Or take the Irish question, which has convulsed the nation so recently. That, if any question, is political. But in the discussion of it, what sort of argument is used? It is said that the act of union, by which the Dublin Parliament was brought to an end, was passed by corrupt means, that it did not receive the assent of the Irish people; and so on, and so on. Well, are these statements true, or are they not true? This is evidently a historical question. To answer it you must consult the record of occurrences which took place at the close of the last century. In other words, you must travel out of politics proper into history. Does not this example show you how far you run the risk of being led, what complicated inquiries await you? Indeed, it seems to me that that immense and pregnant question which was so suddenly brought before us, the question of home rule, involves the greatest of those principles which political thinkers, using a historical method and availing themselves of that vast supply of trustworthy historical information

which till a very recent time was wanting, have established. But have these principles been mastered as yet by our population? I think not. Our political commonplaces, those so-called principles the announcement of which sets all throats shouting and all hands clapping, are in a great degree exploded in the schools. In the schools the historical has supplanted the *à priori* method, whereas the party-world still lives in the dregs of eighteenth-century Liberalism. That impartial view at which you aim is, in fact, a historical view. When the party-scales fall from our eyes, what we see before us is simply history. "The thing which hath been is the thing which will be." Would you know what is wise and right in politics, you must consult experience. In politics, as in other departments, wisdom consists in the knowledge of the laws that govern the phenomena, and these laws can only be discovered by the observation of facts. Now, in the political department we call the observation of facts, history. If this is so, how can we avoid the conclusion that such a study of politics as you meditate cannot be separated from the study of history?

You will allow me, I am sure, thus frankly to point out the difficulties with which you will have to contend. It may prove that a more complicated machinery than you have planned is necessary in order to carry your purpose worthily into effect. And in that case it is, of course, possible that you may find on trial that you have undertaken more than you can perform in a manner thoroughly satisfactory. Even so your society might still be infinitely useful. Its discussions might be suggestive, even if they should not be exhaustive; they might give much, even if they should leave you hungering for more.

On the other hand, you may find yourselves able to give to your society that further development which the plan of it seems to me likely to require. What, in one word, is this further development? To discussion, it seems to me, you may wish to add methodical teaching, and to politics you may wish to add political economy and history. These, indeed, are vast additions; they would convert your debating society into something which we should describe by quite another name, into a sort of institute or college of the political sciences. You may not be prepared, and perhaps even it would not be wise, to look so far forward, to undertake so much at once, or even to indulge the thought of ever undertaking so much. But in a solemn commencement like this, it is impossible not to speculate, at least for a moment, to what height the seed now sown may conceivably grow. In an inaugural address, allow me to adopt for a moment the tone of an augur. It is now seventeen years since, in the Senate House of the University of Cambridge, I delivered a lecture on the teaching of politics. Ever since that time, but especially during the last ten years, I have observed in different parts of the country how the idea of regarding politics as a matter of teaching makes way, and how the demand for political teaching grows. The movement here connects itself in my mind with many similar movements which I have had the opportunity of observing, and therefore I think I can foresee the course it is likely to take. Now observe that if you find difficulties in realizing what you wish, you may get help. You want better knowledge, and you may possibly find, as I have said, the subject too vast for you to grapple with unaided. You may come to think that you want the help of economists and historians, if not of other classes of learned men. Your discussions may leave you craving for something more systematic; they may suggest doubts which you would like to refer to investigators of authority. If so, do not forget that the old universities are now very different from what they used to be. Whatever knowledge, whatever insight can be found there, is very much at your service. If in former times their studies were too little practical, had too little bearing upon the questions which agitate the world, this can scarcely be said now. If in former times the scholars of the universities were wrapped up in monastic seclusion and took little interest in the topics of the day, this again can scarcely be said now. But you are not likely to forget this, for I understand the university extension lecturers have visited this neighborhood. Possibly, however, it has not occurred to you that the two schemes, university extension and this Society for the Impartial Study of Political Questions, belong to and have an affinity with each other. We have at Cambridge economists, and we have also historians who do not shun the actual times in which we are all living. In the extension scheme, and other similar schemes, we have a machinery by which these academic teachers are brought easily within reach of those who in great towns like this feel the want of academic teaching. I do not overrate the value of this kind of help. The time was, no doubt, when such scholastic politics would have been regarded with contempt, and I do not suppose that even now you are accustomed to expect much light upon practical questions from the collegians of Cambridge and Oxford. Nevertheless, I think you have found out already that they have something to give, and if you will only persist in appealing for their help, I believe you will be more and more satisfied with the result. The demand will create the supply. They will find out what you want, and gradually they will prepare themselves to give it. Here, then, is my suggestion. You seem to recognize already that you will need help of some kind. You have asked distinguished men, some of them strangers, to deliver lectures which are to be introductory to your discussions. I say, then, for the future, when you want such lecturers, go for them sometimes to the universities. And if you find, as you may do, that, on such a subject as free trade, for instance, a single lecture, or a pair of lectures, one on each side, is not sufficient, and rather disturbs your mind than quiets it; if you begin to see whole sciences and systems of thought lying under those political questions which you have undertaken to study impartially, then, I say, call the extension lecturers back to Cardiff, and supplement your debates by courses of lectures and by standing classes in political economy and in history.

You see, no doubt, what I aim at. What leads me to take an interest in your enterprise, what has caused me to accept with pleasure your invitation to deliver this address, is that I have recognized here another wave in the great tide of which I have for many years watched the advance. It is our part at the universities to give coherence, connection, and system to the thinking of the nation. I see everywhere how the nation begins to strive more than in past times towards such coherence. I am glad also to see how it learns the habit of looking to the universities for help in this strife, and how rapidly the universities are acquiring the habit and the skill to render such help; and I look forward to the time when the English universities will extend their action over the whole community by creating a vast order of high-class popular teachers, who shall lend their aid everywhere in the impartial study of great questions, political or other, and so play a part in the guidance of the national mind such as has never been played by universities in any other country. It is in this hope, and as a step to the fulfilment of it, that I inaugurate and wish all success to your society.

ELECTRICAL SCIENCE.

The Solution of Municipal Rapid Transit.

THE paper read by Mr. F. J. Sprague before the Institute of Electrical Engineers, on municipal rapid transit, is both valuable and timely. In the first part of the paper the inadequacy of the almost universal system of horse-car traction is pointed out, and a comparison is made between horses, cables, and electricity. Taking up horses, Mr. Sprague says: "Two distinct methods are recognized among street-car men in the handling of their stable equipments. In one the stock of horses is kept as low as possible: they are worked hard, making fourteen or fifteen miles a day, and the depreciation is heavy. In the other the stable equipment is increased, the horses are kept in excellent condition, their average daily duty is reduced to ten or twelve miles, and the depreciation is lessened." As an example of the equipment required, on the Fourth Avenue line in New York, run on the latter plan, the car day is eleven hours, and eight horses make about five trips, aggregating about fifty miles. To the number of horses is added ten per cent for illness, and ten per cent for emergencies; that is nearly ten horses for a car, making fifty miles a day. The average cost of motive power per car day throughout the United States is about four dollars, counting the cost of only those horses that are actually on duty. The cost per day per horse in New York is on the average fifty-four cents, and the cost for motive power per car mile ten cents.

The cable system has been successfully used where there are heavy grades and a great deal of traffic. In this system a cable is

run in a conduit between the tracks, and the cars make connection with it by a grip passing through a slot in the conduit. There are several objections to this system. One of the most serious is the initial cost, the conduit alone costing from $50,000 to $80,000 per mile of single track. The conduit must be made large, it is difficult to clean, the pressure is liable to distort it and close the slot; its depth — varying from two to three feet — is liable to interfere with steam, gas, or water pipe. A break in the cable will suspend the entire traffic on the line. A broken strand is apt to foul the grip and pile one car on another, as has happened in Philadelphia. The efficiency of the system is not over twenty to twenty-five per cent, while to guard against accident the engine outfit is usually from two to four times that required at any time. Any extension of a cable line is expensive because the length of the cable is fixed. The speed of the cars is limited to that of the cable, so there is no chance for them to catch up if they get behind time; the motion, too, is uneven and unpleasant.

For electric traction Mr. Sprague claims the following advantages. It will do the work more satisfactorily and at a less cost than horses; on levels and up and down grades electric-motor cars can be run much faster than horse-cars; they can be gotten under way and stopped much more quickly; the equipment will occupy thirty-five per cent less space than horse-cars, the horse space being saved, and this fact, together with the ability to back when necessary and to quickly gain headway, enables an electric car in a narrow and crowded street to work a passage through where horse-cars would be stopped. Electric cars can be run more safely on down grades, since if the brake-chain breaks the car can be controlled by the motors, reversing when necessary. The motion of an electric car is smooth, and its starting and stopping are easy; the cars are clean, they can be lighted and heated by electricity; the streets are cleaner, and objectionable stables are not needed. It becomes feasible to operate branch lines, and also combinations of grades, curves, and ill-conditioned streets, that would be prohibitory to any other system.

To the objections that have been urged against electric systems, — that an extended system cannot be operated by electricity, that the lines may break down, that a large number of cars cannot be operated simultaneously, especially when bunched up, and that armatures and brushes burn up, — Mr. Sprague opposes his own very extensive experience, especially in the case of the Union Passenger Railroad in Richmond, where all of these difficulties have been met and overcome.

Before giving the details of the Richmond road, Mr. Sprague explained from curves some important points in the theory of electric motors for traction work. Discussing the different methods of gearing the armature of the motor to the axles of the car wheels in order to reduce the velocity, he concludes that there is only one good way, which is to centre the motor on the axle, suspending it flexibly from the car body or truck, and driving the axle by gearing with one or two reductions according to the nature of the service.

Taking up the methods of supplying the current to the motors, from storage-batteries on the cars, from overhead wires, or from wires in a conduit underground, Mr. Sprague first discusses storage batteries. These he considers as extremely promising for surface traction, but at the present state of development the excessive weight, the depreciation and cost, lack of capacity, and the space taken up in the car, make their success problematic. The weight of the car is so great — almost 20,000 pounds for a loaded car — that many of the tracks now in use would have to be rebuilt for them.

The difference in cost between an overhead and conduit system is mainly in the cost of the conduit, $25,000 to $30,000 a mile. The latter has the advantage that there are no overhead obstructions, and it can therefore be used in streets where the former is not permitted. Its disadvantages are cost, possibilities of leakage, and difficulty in cleaning and repair.

The overhead system is cheap, easily insulated and repaired; if properly constructed it need not be unornamental nor dangerous, — in fact the electrical pressure should not be great enough to endanger life. Mr. Sprague recommends this system for suburban districts, for comparatively narrow streets, for all streets operating under an elevated railroad structure, or where the tracks are near a sidewalk.

To illustrate the advantages of electricity for certain classes of traction work, Mr. Sprague proceeded to describe the equipment and operation of the Richmond street railroad, a description of which has appeared in this journal. The road is a difficult one, practically impossible for horse traction. There are grades of over ten feet in a hundred, and curves of small radius on heavy grades. The total trackage is twelve miles, the equipment is forty cars. Each car axle is geared to a motor of $7\frac{1}{2}$-horse power, capable of working up to 15-horse power if required. The motors are out of sight, and are practically noiseless. The system used is the overhead. The power station is in the middle of the line, and is provided with boilers and engines of 375-horse power. In distributing the current a main conductor is taken along the line of track, either on the poles or underground, and is connected at intervals to the overhead working conductor, from which the current is taken. This allows a small overhead wire, and a break in it will not interrupt the traffic on the line. The return circuit is through the car-wheels to the rails and the earth. This road has been running long enough to allow reliable figures as to the expense being obtained. It is found that the cost of power is $1.48 per car day, the car making eighty miles, and of material, labor, and depreciation, $1.98 per car day; the total being $3.46 per car day, or 4.32 cents per car mile. This is to be compared with the ten cents a car mile that horses cost, and in the latter estimate there is no allowance for depreciation of cars, etc. At present there is a saving in this line of $125 a day as compared with horses. The passengers carried are over 10,000 per day.

Passing to the application of electricity on a larger scale, Mr. Sprague considers the problem of the elevated roads. At present steam engines weighing $22\frac{1}{2}$ tons, with a capacity of 185-horse power are used. For a proper service the number of cars should be increased at certain hours, but the weight of the locomotive will not give traction enough for the desired increase, and the strength of the structure will not allow an increase in its weight. As to the energy used, 59 per cent is employed in starting, 24 per cent in lifting, 17 per cent in traction; the average horse power is 70.3. Mr. Sprague's substitute for the locomotive is a car with an electric motor geared to each axle. In stopping and in going down grades he will brake by making his motors into dynamos, feeding current into the line for the other trains, thus recovering a part of the energy lost in starting and in going up grade. The motors are to have a collective capacity of 300-horse power, and the car will be used for passengers: at each end of it will be a compartment for the motor men.

Mr. Sprague's ideal railroad system for New York is as follows: There would be four tracks from the Battery up Broadway to Twenty-third street; thence diverging in two divisions, each still with four tracks, one along the line of Madison Avenue to the Harlem River; the other following Broadway and running up the line of the Boulevard and Tenth or Eleventh Avenue. Two tracks would be for express, two for way traffic: they would be in two tiers, the former below the latter. Electric cars are to be used, the current delivered from an overhead wire; express speed, thirty miles, way trains, twelve miles per hour. This system is to be supplemented by surface cars operated by electricity.

These are the main points in Mr. Sprague's paper, which will be discussed in the fall meeting of the Institute of Electrical Engineers.

MENTAL SCIENCE.

Experiments in Thought-Transferrence.

THE English Society for Psychical Research has definitely accepted the theory of telepathy, or a mode of communication between mind and mind other than that through the recognized channels of sensation. A portion of the evidence upon which they found that belief is of an experimental nature, and it is this portion that is most apt to arouse the attention of scientific men; it is this portion, too, that is certain to bring to light obscure phases of mental action, irrespective of the answer it may yield as to the possibility or impossibility of thought-transferrence. In the last issue of the Proceedings of the English Society (June, 1888), M. Charles Richet, well known as a physiologist, and editor of the

Revue Scientifique, contributes a full account of his varied and elaborate researches in this new field.

These experiments, coming from so eminent an experimenter, made with a sound knowledge of the sources of error inherent in such work, and presented with a pleasant modesty, are worth the consideration equally of those who do not agree with the conclusions of M. Richet[1] and of those whose views are strengthened by these new experiments. M. Richet has been pursuing this investigation for six years, and, if he has been deceived by his subjects, it can only be that the topic presents an unusually puzzling and deceptive aspect.

After an introduction dealing with the precautions to be taken, and emphasizing the fact that at bottom we must trust to the honesty of our subjects, he can do no better than ask the reader to take his word for the observed good faith of the subjects, and equally well assure the reader that he has ever been on his guard against that greatest of wonder-workers, 'unconscious self-deceptions.' Furthermore, we must require only such a degree of probability for our results as would be satisfactory in other sciences. The slightest defect invalidates the whole observation, and a well-established, not very wonderful result is to be preferred to a striking one less securely established.

His subjects are four hysterical women between the ages of twenty-one and forty-five, all subject to hypnotism, and some with a tendency to natural somnambulism, and other signs of an unstable nervous constitution. The first test consisted in willing the patient to go to sleep, M. Richet being at a house five hundred and fifty yards distant. On going to the house he puts the subject to sleep, and she tells him that for a certain twenty minutes of the morning he was trying to put her to sleep, and that she went to sleep. The time is approximately correct. The experiment is varied, and the coincidence of the time of M. Richet's willing and of the patient's sleeping varies from a remarkable exactness to quite wide approximations. However, M. Richet is convinced that the successes are more numerous than can possibly be explained as due to chance. Between coincidence and telepathy, he chooses the latter.

Very many attempts were made to transfer a simple drawing from M. Richet's mind to that of the subject. Many illustrations of the result are figured, and without such illustrations it is useless to describe the result. But the new fact that M. Richet records is that the experiment succeeded nearly or quite as well when he was ignorant of the design contained in the envelope as when he knew it. Here thought-transferrence is out of the question, and M. Richet has recourse to the theory of a sort of clairvoyance to which he gives the generic name of 'lucidity,' a vision in which the ordinary optical impediments no longer act as such. It must be added, that as a rule the subject did not draw her reproduction, but described it part by part, and it was drawn by M. Richet. Selections from the most successful sixth of the results are alone described. Moreover, the very admirable plan was adopted of experimenting with normal subjects by selecting sixty designs, and recording the good results. For seven successes in two hundred with these subjects, he can show twenty with his selected subjects, so that the normal degree of success is to some extent ascertained.

Another and very questionable form of test was to have the subject, either in a normal or hypnotic state, describe the disease of a patient thought of, or a lock of whose hair was shown. The descriptions are in vague terms, and the amount of success is by no means remarkable.

Experiments were made in which the letters of an alphabet are moved over by one person, while a group of persons sit at a table, and the letters are recorded at which the pen stopped when the table moved under the more or less unconscious impulse of the sitters. When these letters are put together, they form a more or less close resemblance to what was thought of or asked for. The fact that sentences thus emerge, if fact it is, is certainly extremely wonderful.

Experiments with cards were tried; and the success in guessing the color, the suit, and the grade, compared with the success by chance, yields the result that no evidence of 'lucidity' is present. The guessing of names was no more successful. Other observations of a miscellaneous character, and dealing with coincidence, are recorded. These give one the feeling that a great many wonderful things have been happening to M. Richet since he has become interested in this study.

M. Richet takes the position that chance or a new mode of mental action is the only way of explaining the results. This is far from self-evident. On the contrary, it is infinitely more probable that a natural mode of explanation has escaped our observation, and especially so in this unexplained region of mental phenomena. We know, as M. Richet points out, how very shrewd subjects are in anticipating results by unconscious suggestion, and the limits of this power have by no means been reached. We ought, then, to so arrange our experiments that this power finds no field for application. It is not sufficient to refrain from all conscious intimation of the expected result, but this result must not be capable of any such intimation. It is in this point that M. Richet's experiments are sadly deficient. Instead of finding when his subject went to sleep by her account of it, let a schedule be arranged that five times per day for a period of fifteen minutes he should will the distant subject to sleep; then let the hours be determined by hazard, and record the result. Everywhere we require simplicity of conditions with the amount of success due to chance precisely calculable. It is striking that the card experiments, which alone answer this condition, are entirely negative in result. Again, the drawing experiments are useless until we have a system of calculating successes. The designs are largely the combination of a few elements; and if, as M. Richet at times does, we calculate the appearance of one of these elements as a partial success, it is easy to prove telepathy. Finally (for objections could be indefinitely multiplied), the inference from the fact that success was obtained when the operator did not do the drawing, is not that we must suppose lucidity, but that this is excellent evidence against telepathy, and strongly suggests that the percipient has some method of seeing enough of the design to get three times as many as the normal number of successes. The problem is by no means a simple one, and theories of any kind are premature. In maintaining a scientific interest in such phenomena the Psychic Research Society is performing a very useful function.

THE PSYCHOLOGY OF SPIRITUALISM. — In the July number of the *American Magazine*, Dr. Allan McLane Hamilton writes to the point in reference to the delusion which has recently figured in the law courts. He shows the relationship of this to other psychic delusions, and describes the conditions under which false mental images arise, and lead to the weakening of the judgment.

BOOK-REVIEWS.

The Constitution of the United States, with notes. EDWIN D. MEAD. Boston, Heath. 16°.

THE proprietors of the Old South Meeting House established in 1883 a series of lectures on historical and political subjects, with the special object of instructing the young. The lectures have proved popular, and are doubtless doing good; so that the hope is now entertained that they will be permanently continued, and will give rise to other courses of like character elsewhere. In connection with these lectures a series of pamphlets have been issued, called the 'Old South Manuals,' of which this copy of the National Constitution is one. It is of convenient size and well printed. The notes are historical and bibliographical, and though of necessity brief, they convey a good deal of information, and will be specially valuable as showing the student where to go for further instruction. The editor of the work, as well as the managers of the lectures, take a broad view of the subject with which they deal, and are not among those who think that American history and politics can be studied apart from those of the world in general. The vital connection of our institutions with those of England is fully apprehended by Mr. Mead, and several of his notes are devoted to this subject. The leading authorities on both English and American constitutional history are pointed out, and the student who wishes to pursue the subject thoroughly will find this little book a sufficient and trustworthy guide.

[1] The present writer counts himself among this number, and, inasmuch as it is impossible to eliminate individual opinion in so new a question, will criticise the experiments from this negative point of view.

NOTES AND NEWS.

ALL intending to be present at the meeting at Cleveland of the American Association should write to the Local Committee, 407 Superior St., for a copy of their circular giving full particulars of the course to be pursued in order to benefit by reduced fares. Certain conditions must be fulfilled before reaching the meeting.

— Jean-Charles Houzeau de Lehaie, honorary director of the Royal Observatory at Brussels, died at Schaerbeek, July 12. He was born at Mons on the 7th of October, 1820.

— Courtlandt Palmer died, July 23, at the Lake Dunmore House, Lake Dunmore, near Brandon, Vt., of peritonitis. Mr. Palmer will be remembered as the founder of the Nineteenth Century Club, a debating society devoted to the discussion of social, literary, artistic, theological, and scientific problems in the spirit of the broadest liberality, which has been held together for more than five years by the force of his energy and enthusiasm. Mr. Palmer has always been the president of this organization. Its first meeting was held at his residence, in Gramercy Park, in January, 1883, and for some time afterward the membership of the club was small enough to enable the president to offer to it the hospitality of his home. But the membership increased, and it became the fashion in polite society to attend the club meetings. The rooms of the American Art Association, on Madison Square, were secured, and half a dozen meetings were held every winter. Last season the club changed its meeting place to the handsome assembly rooms of the Metropolitan Opera House. There is no question that the Nineteenth Century Club has done good work. Mr. Palmer's enthusiastic devotion to his society never relaxed. By profession he was a lawyer, and he was born in this city forty-five years ago.

— The July–August number of *The Art Review* begins Vol. III. of the magazine and the new series of bi-monthly issues. The latter mode of publication will not only allow more time and care in the preparation of the 54 art supplements given annually by the magazine (6 etchings, 6 wood-engravings, and 42 full-page photogravures reproducing American scenery, paintings, statuary, architecture), but will also be better adapted to the review character of the articles, — descriptive and critical accounts of the more important exhibitions in New York and elsewhere, of our public art museums and private galleries, of picturesque American scenery, of the art status of leading American cities, of American architecture and industrial art, of American prints, coins, etc., as well as articles on general art topics, embracing both foreign and American art. In conformity with the reduction in the number of issues per annum, the subscription price is reduced from $10.00 to $7.50 a year. —— Encouraged by the cordial reception given to *The Art Review*, the editor and publisher of the *Review* (Mr. George Forbes Kelly) will begin in September next a new art periodical, entitled *The Art Courier*, issued twice a month, or 24 times a year. This publication will aim to give the art news of the fortnight, presented in readable style, with brief editorial comments. Each number will have, as its art supplement, a photogravure, and these 24 plates will be furnished with the letter-press for the low price of $4.00 a year. —— Of the series of railway articles in *Scribner's Magazine*, the third, entitled 'American Locomotives and Cars,' by M. N. Forney, will appear in the August number, and will be entirely different in subject-matter, treatment, and illustration from the two preceding articles, which dealt with the construction of the road-bed. Mr. Forney will describe the evolution of the modern locomotive from Peter Cooper's engine, which weighed less than a ton, and the typical passenger car from the old stage-coach. —— In the August number of the *Atlantic Monthly* two timely and practical contributions, which will be given close attention just now, are Horace E. Scudder's article on 'Literature in the Public Schools,' and a review of the new book of 'Political Essays,' by James Russell Lowell. Another practical contribution is furnished by President Eliot of Harvard under the caption 'Can School Programmes be Shortened and Enriched? —— The new number of Ticknor's admirable Paper Series of original copyright novels is 'The Rise of Silas Lapham,' by W. D. Howells. —— *The Popular Science Monthly* is doing splendid service in showing the aspect of the great questions of the day from the scientific standpoint. The August number opens with an article entitled 'The Octroi at Issoire: a City made Rich by Taxation,' by President Jordan of the University of Indiana, which gives the imaginary history of a French town that sought prosperity through a high tariff. —— The article, 'A Rare Fish,' in *Outing* for August deals with the salmon fishing of the Saguenay River. —— In the August *Magazine of American History* 'The Conquest of the Mayas' is the fourth and concluding paper in Mrs. Alice D. Le Plongeon's historical sketches of Yucatan.

— The first report of this season's work has been received at the Hydrographic Office from the United States steamship 'Ranger.' The preliminary triangulation of Sebastiano Viscaino Bay, Lower California, has been completed. In order to make this triangulation, a party was left at Lagoon Head, in camp, with a heliostat constructed on board the 'Ranger' by using a state-room mirror. The flash was seen and cut in from Cerros, sixty miles distant, on a remarkably clear day, so that the triangulation was easily connected with a system of well-conditioned triangles to the base line measured at San Bartolomé Bay. The heliostat furnished to the ship is effective for a distance of forty miles, but could not be seen from Cerros. The aggregate length of the sides of the various triangles constructed was about a thousand miles, and the length of coast line surveyed, one hundred and nineteen miles. Ten places were occupied on the coast for the determination of the magnetic declination. The observations at Rosalia Bay show that the point of maximum easterly deviation has passed, and that now the declination is decreasing at that place. The hydrography is completed to Point San Eugenio. The great bay of San Sebastian Viscaino is well sounded out, and the east coast of Cerros Island is finished to within three miles of the north end.

LETTERS TO THE EDITOR.

A Pseudometeorite.

ON JUNE 26 the Minneapolis, Minn., *Tribune* printed a special despatch from Rochester, Minn., stating that a meteorite weighing 203 pounds had fallen on the premises of Mr. A. Sias of that place; that the stone measured 20 inches in length and 12 inches in thickness, and was covered with a black varnish-like coating.

A small piece was kindly sent me by the owner, who also informed me that it was found in a gully which had about eighteen months ago been washed out by a freshet and since then had filled in with limestone. On this pile he found what he believed to be a meteorite.

The fragment sent is red hematite, probably from the Lake Superior region, and not of meteoric origin.

The finders still believe it to be a meteorite, because they cannot see how a mass of hematite could reach there. It is probable that this mass was left in an ore car and thrown out at the limestone quarry where limestone was obtained for flux, and subsequently carted from there with the limestone used in filling up the gully.

GEORGE F. KUNZ.

New York, July 23.

Professor Loizette's Memory.

I AM glad that in your issue of July 20 you properly characterized 'Professor' Loisette's memory system and methods. I am one who started to become a pupil by 'correspondence,' and ended by becoming a victim. Having received, after the proper payment, the 'secret' lessons, I proceeded according to directions and transmitted a copy of my work for correction as per contract. Did I receive any attention? Not the least. Another letter, enclosing the proper stamps and explaining the first, drew no further response than a duplicate copy of the printed lessons and a pamphlet of useless advertisements. The 'Professor,' who had been so ready to receive my fee, did not deign, in person or by clerk, write a word, and I became conscious that I had been swindled. It is time, as you suggest, that I ought to have known better; but the most cautious are sometimes 'taken in,' and become an illustration of the adage that 'a fool and his money are soon parted.' However, although at considerable cost, I admit that the 'Professor' has improved my memory to that extent, and if I may serve as a warning to others, my experience may not be without its benefits.

CHARLES FLUHRER.

Grand Rapids, Mich., July 23.

Positions Vacant.

Inquiries from employers in want of those skilled in any department of science in its widest sense will be inserted in this column WITHOUT CHARGE.

The labor and expense involved in ascertaining what positions are open, in gratuitously advertising them, and in attending to the correspondence of applicants, are incurred in the interest and for the *exclusive* benefit of *subscribers* to *Science.*

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SCIENCE

FRIDAY, AUGUST 3, 1888.

A RECENT NUMBER of the Journal of the Society of Arts contains information of the projected railways in Asia Minor. A new railway is projected from Constantinople to Bagdad, to start from Ismid, the present terminus of a short line of railroad connecting that town with Scutari, the Asiatic suburb of Constantinople. Its length is about 1,400 miles, and the estimated cost is $75,500,000. Throughout its length it will traverse a country well populated, abounding in mineral resources, and producing great quantities of grain. British consul Jewett, of Sivas, says that the great advantages to the country, commercially and as a civilizing influence, of such a road are too obvious to need mention. It is sufficient to say that it would create a new Asia Minor, open to the trade of the world a vast territory now closed, totally change the character of the country and the people, and practically advance Turkey in Asia from the sixteenth to the nineteenth century; moreover, the commercial world at large has a special interest in this project, as it will, if carried out, shorten the distance between Europe and India by nine or ten days, and give a route to the East independent of the Suez Canal. Should the railroad be built, it is said that Bagdad, as the *entrepôt* for the trade between the East and the West, is sure to attain a commercial importance hardly second to any city in the East. With the advent of the railroad, with the new towns and cities that will spring up, the new resources and industries developed, and especially with the new ideas and wants which civilization creates, there will be a new market, and a constantly increasing demand for almost everything which Europe and America manufacture.

WITH THE REAPPEARANCE this spring of our native birds in great numbers we expected to hear from some of our ornithologists as to a reasonable explanation, The reappearance was first noted in the New York papers, and was promptly credited to the liberal destruction of the pugnacious English sparrow, unable to withstand the storm-beating received in the great March blizzard. But counter to this explanation comes information from Illinois that the attention of all is attracted to the remarkably large number of birds that are to be seen. The groves, the woods, and the meadows in the country, and the many trees in the city, are peopled with these feathered visitors. The oldest inhabitant does not remember to have seen so many and such a variety of birds. And yet the great blizzard did not visit Illinois. The July *Auk*, the quarterly organ of the ornithologists, contains no hint as to the cause of this sudden return of the old birds, which we had been led to believe were so vastly reduced in numbers that only after a long respite from the attacks of the sparrows and the country's shotguns could they possibly be restored to us in their former numbers. The birds are here, as numerous as ever, and have returned *en masse*.

THOMAS HUMPHREY WARD has published a 'Letter to the American People' on international copyright in works of art. The special occasion of this letter was the placing in his hands by a friend of a parcel of 'process' engravings and a number of trade catalogues issued by American publishing houses. These process engravings, and the grievance to which they have given rise, are an entirely new fact in the world of art. They are the result of the most modern improvements in the art of reproducing pictures. They bear many names. They are called 'artotypes,' 'heliotypes,' 'albertypes,' but they are all varieties of the same method, — the method of applying photography to the purposes of engraving. They are, in fact, reproductions in photo-engraving of the best, the costliest, and the most popular modern English and French engravings and etchings. They are of imposing size, the artotypes measuring, when mounted, thirty inches by forty, and thus approximating to the dimensions of the engravings which they copy. They are showy, effective, and, to use the language of the workshop, 'well got up.' They are in no sense botched or bungled. They are quite a different thing from the German lithographs of our childhood, those *naïve* attempts in art by which the last generation of continental contrabandistas used to impose upon an unsophisticated world. These things are as like the works they counterfeit as the sun and the printing-press can make them. During the past ten or fifteen years, that is to say, since the recent great development of 'processes' has enabled American publishers to destroy the American demand for the first-hand works of European artists, their remuneration has fallen to a great extent. Fifteen years ago it was quite a common thing for an artist like the late Mr. Cousins to be paid a thousand pounds for a mezzotint plate, for the publisher who commissioned him knew that there were a sufficient number of buyers in Europe and America, taken together, to make such an outlay remunerative. It is not asserted that there are no longer men who can command a similar price, but they are so few that their existence hardly makes a difference in the question. In the case of one or two Englishmen, and one or two French or Dutch etchers, it is still possible for the publishers to give these heavy commissions. Fashion still points that way, and while the fashion lasts these men can be employed; but in the case of the great majority, even of distinguished engravers, the demand for their work is lamentably less than it was, not from any failure of appreciation on the part of the public, not from any failure of power on the part of the engravers, but simply because the returns are less than they used to be, and less almost exclusively on the American side.

IT IS THE CURRENT BELIEF that there has been nothing like the present Cincinnati Exposition since the great one at Philadelphia in 1876. People who were at New Orleans is 1885 say that this is enormously superior in all the arts, especially upon the mechanical and industrial side. The Exposition covers fifteen acres in the very heart of the city, and in every part of this large area one meets evidences of taste, skill, ingenuity, and perseverance in adapting means to ends, which form a series of apparently never-ending surprises as one passes from one exhibit to another. The government exhibits are all good and all characteristic. The Smithsonian Institution and the Geological Survey exhibits attract crowds. In the latter Prof. F. W. Clark has some transparent photographic views, represented in colors by some new and as yet undisclosed process. The effect is wonderfully natural and beautiful, and if it is found to be durable it will prove a great discovery. The very fine models of the new classes of naval vessels now building attract crowds daily, as do the various forms of weapons for wholesale slaughter in case we ever have another war. In close juxtaposition are the ingenious devices for saving life in cases of shipwreck, of the Life Saving Service. The Fish Commission exhibit is not as yet complete. In such elaborate displays, requiring much preparatory work, more time should have been allowed for preparation. The Post Office Department and the Army exhibits are also incomplete, but a few days will find every thing in order.

IN A RECENT NUMBER of *The Forum*, Mr. Lester F. Ward has an article on 'What shall the Public Schools Teach?' In this article Mr. Ward maintains that in refining upon the blessings of education we forget altogether what knowledge is for. His definition of civilization being that it consists in 'the utilization of the materials and forces of nature,' he holds that so far as the improvement of man's estate is concerned we know only in order to do, that knowledge unapplied is sterile, and is only fruitful when it makes two blades of grass grow where only one grew before, when it converts 'raw material' into useful objects, or when it directs into some useful channel the forces of nature which were previously running to waste or doing injury to man. Mr. Ward believes that nowadays all inventions are in the nature of 'improvements' upon pre-existing inventions, and are chiefly made by the mechanics or artisans of the higher grades, who are constantly using the original devices, and who, through an intimate acquaintance with these, eventually perceive how they may be improved; that as artisans become more intelligent this class of inventions will increase, and that nothing but the stolid ignorance of the working-classes in the past has prevented this from having always been the chief mode of advancing the useful arts; and the hope is expressed that in the near future the artisan as well as the engineer may not only receive a good education in the hitherto accepted sense of the term, but may also have such a training of the eye and the hand as will enable him to perceive and to effect all possible reforms in his chosen field of labor. Everywhere we see the lack of thought directed to the improvement of our material surroundings. If this is because the importance of improving those surroundings forms no part of the education which is given to the youth of the country, there is reason to believe that any system of education which will tend to develop the human powers of dealing with materials and forces will tend to raise the plane of civilization as defined. Mr. Ward even looks forward to the day when the need for the use of the human animal for the lowest forms of unthinking labor will be done away with, which would simply mean that there would be less opportunity for life among those of low intelligence, and that the 'average man' would be on a higher plane than at present.

This tendency to educate youth so that man may be the better able to deal with his material surroundings is doubtless wise, but brings forth a remonstrance occasionally from those versed in the old ways, who hasten to point out the other sides to a man's nature which come in contact with other conditions which he should be equally ready to contend with, or perhaps better to appreciate. The recently published life of the most illustrious and most amiable man of science of this scientific age has suggested to many readers doubts of the all-sufficiency of science to build up, not theories, but men. Mr. Darwin's admirably candid avowal of the gradual extinction in his mind of the æsthetic and religious elements has proved startling to a generation which, even when it is ready to abandon religion, would be direfully distressed to lose the pleasures afforded by art and nature, poetry and music. Instead of lifting the scientific vocation to the skies (as was probably anticipated), this epoch-making biography seems to Miss Frances Power Cobbe, writing of 'The Scientific Spirit of the Age,' in the *Contemporary Review*, to have gone far "to throw a sort of dam across the stream, and to have arrested not a few science-worshippers with the query," as Darwin wrote: "What shall it profit a man if he find the origin of species and know exactly how earth-worms and sun-dews conduct themselves, if all the while he grow blind to the loveliness of nature, deaf to music, insensible to poetry, and as unable to lift his soul to the divine and eternal as were the primeval apes from whom he has descended? Is this all that science can do for her devotee? Must he be shorn of the glory of humanity when he is ordained her priest? Does he find his loftiest faculties atrophied when he has become a 'machine for grinding general laws out of large collections of facts'?"

THE COAST AND GEODETIC SURVEY EXHIBIT AT CINCINNATI.

THE exhibit of the United States Coast and Geodetic Survey at the Cincinnati Exposition shows the principal instruments used in the geodetic, astronomical, topographical, hydrographic, and magnetic work of the Survey, with illustrations of the results of their use, as shown by a series of the annual reports, a number of the principal charts published, a collection of the more important scientific papers or works printed by the Survey, a model of an observing tripod as used in geodetic work, and models showing the basins of the Gulf of Mexico and of the western Atlantic, or 'Bay of North America,' constructed from the data furnished by the elaborate hydrographic surveys of those waters. The collection further includes an exhibit from the United States Bureau of Weights and Measures, which is under the care and direction of the Superintendent of the Coast and Geodetic Survey.

The Exposition occurs at a period of the year when many of the best instruments of the Survey, containing the latest improvements in their several departments of use, are in the hands of field parties and cannot be exhibited. To aid those interested in the exhibit, a pamphlet has been issued by the Survey explaining the instruments shown and their uses.

The great end and chief object of the Survey is, and has been, for a period of half a century, to furnish good and reliable charts of the coasts of the United States, and of its harbors and navigable rivers. These require in their construction a combination of skilful labor, differing greatly in means, appliances, and methods.

First in order is the reconnaissance and triangulation. Next comes the topographical survey of all that portion of the earth's surface which lies above the water. It includes all accidents of ground, all natural or artificial developments of surface, and every thing useful for purposes of commerce or defence.

Third in the chronological order of conducting a survey, but equal in its usefulness, is the development upon the chart of all that portion of the earth's surface which lies beneath the water. This important work is carried on by officers and enlisted men of the navy of the United States. There are 67 officers and 280 petty officers and seamen now engaged upon this duty. The instruments used in the work are only partly shown.

Although one of the minor branches of the operations of the Survey, the study and the application of the results of terrestrial magnetism from a practical point of view are of great importance, not only to the surveyor, but also to the mariner, to whom they are indeed indispensable.

This will be readily understood by simply referring to the extended use surveyors have made of the magnetic needle for the demarcation of land and the consequent frequent necessity of retracing old lines so laid out and recorded.

With reference to the use of the compass at sea, the charts of the Survey require the impress of the compass, they record the variation of the needle, and state the annual change so as to render the sailing directions applicable for other years than that of the issue of the chart. With reference to the adjustment of the compass on board ship, and the construction of deviation tables to answer for different directions, inclinations, and positions of the ship, a knowledge of the magnetic dip and the intensity is demanded. The labors of the Survey and their results may best be shown by a short historical review.

In the early years of the Survey under its first superintendent, the magnetic declination (the scientific term equivalent to the mariner's 'variation') was supplied to the charts as found by the ordinary nautical instrumental means then in vogue. In the Transactions of the American Philosophical Society (Philadelphia, 1825), he proposed to measure relative magnetic intensity by means of oscillations of a needle. The magnetic work of the Survey, however, may be said to have commenced in its three-fold aspects, the declination, the dip, and the intensity, with his successor in office in 1843. Professor Bache had previously made a magnetic survey of Pennsylvania, which, although a scanty beginning, was not followed until in quite recent years by the magnetic survey of Missouri. He imported new instruments suitable for more refined measures of the declination than could be secured by the older in-

struments, and at the same time capable of exact determinations of the intensity in absolute measure; he also procured dip circles, and availing himself of the additional temporary aid of Dr. Locke of Cincinnati and of Professor Renwick of Columbia College, the observational work was fairly started, and has since been prosecuted uninterruptedly by various assistants of the Survey. In consequence of the dual or polar character of the magnetic force, it resisted for a long time all attempts of measure expressible in the usual units, but in 1833 Gauss showed how this could be done, and after the invention, in 1836, of the portable magnetometer his method for the absolute measure of magnetic intensity came into general use.

Those who are acquainted with magnetic observations, which also include certain astronomical operations, know the delicacy and refinement of its operations when great accuracy is demanded, and it should also be remembered that in those early days of the development of practical methods there were none of those facilities we now possess in the number of trained observers, in the home manufacture of instruments, and in the many treatises for instruction now at hand. Apace with the field work the office work of computation and discussion was prosecuted, and the results were published from time to time in the annual reports.

At first the observations were confined to the vicinity of the seacoast, but it was soon found that the charts could not satisfactorily be supplied with the values for the variation of the compass unless the observations were extended sufficiently inland to give proper direction to the magnetic lines, or isogonics as they are called, which curves determine the angular difference between the astronomical and magnetic meridian for a certain epoch. Meanwhile, surveyors from all parts of the country applied for information, not only for the present value of the declination, but what was far more difficult to answer, for the value at some earlier period. To satisfy this inquiry, and to provide for a better knowledge of the annual change of the declination needed for the charts, a more systematic general collection of all magnetic observations taken within the limits of the United States from the earliest to the present time was undertaken, and has been kept up since 1878, at which time the field of activity of the Survey was enlarged by the change of Coast into Coast and Geodetic Survey. This collection arranged by States and Territories now comprises several thousand observations of declination, dip, and relative and total intensities, and together with the direct survey work, which in July last comprised 731 stations (many of them occupied several times at definite intervals), constitutes the material from which most of the deductions were derived, and which mark the advancement of our knowledge in this department of research contributed by the Survey.

The first permanent magnetic observatories in North America were established at Toronto by the British Government about 1840 (which observatory is still in operation under the auspices of the Canadian Government), and about the same time at Philadelphia, 1840–45, at Girard College. The latter was directed by Professor Bache, who, after taking charge of the Coast Survey, took advantage of the newly invented application of photography to automatic registration, procured one of Brooke's magnetographs, and caused it to be set up and to record continuously the variations of the declination and of the horizontal and vertical intensities at Key West, Fla., between 1860 and 1866. After the lapse of half a sun spot cycle, which is the minimum duration for which it is profitable to keep up continuous observation at any one place, the instruments were transported to Madison, Wis., where between 1876 and 1880 a second series of observations was procured. When the support and co-operation of the Survey was asked for the two international expeditions fitted out by the United States for polar research, the needed magnetic instruments, both absolute and differential, so far as the Survey could supply them, were furnished and the observers were trained during the short time permitting.

The magnetic records of the second year (1882–83) at Point Barrow, Alaska, by the party in charge of Lieutenant Ray, were made by the Brooke magnetometers, which had in the mean time been altered for direct or eye-observations.

A superior self-recording magnetic apparatus, known as the Adie magnetograph, after the Kew pattern, and likewise working by means of photography, arrived here during the late war, but for want of funds was not set up until 1882. This superior instrument was located at Los Angeles, Cal., and continues to give excellent results. It is intended to terminate this series towards the beginning of the next year, and then remount the instrument, either in Washington Territory near Puget Sound, or in southern Texas, in order to cover as much as possible of the space for which, heretofore, our knowledge of the laws of terrestrial magnetism was most incomplete.

The first isogonic chart published by the Survey, entitled 'Lines of Equal Magnetic Declination,' will be found in the annual report for 1855, the last one in three sheets appeared in the annual report for 1882: a comparison between these charts will show in the most conspicuous manner the progress made in our knowledge in this direction during the interval. The index to scientific papers in the annual report for 1881 under the heading of 'Terrestrial Magnetism,' enumerates no less than sixty-six titles up to the close of 1880; this will give some idea of the activity of the Survey in this department. Several important investigatations have appeared in the later annual reports; in the report for 1882 we have an appendix discussing the distribution of the magnetic declination in the United States for the year 1885; the results are based on observations at more than 2,300 stations. In the report for 1885 we have an investigation of the magnetic dip and intensity, with their secular variations and their geographical distribution in the United States. This appendix, 145 quarto pages, involved much labor for its preparation: it is accompanied by three finely excuted charts, besides the illustrations in the text, and discusses no less than 2,000 dip observations and more than 1,500 observations for intensity. The results for secular change of dip and intensity are new. In the report for 1886 (not yet issued) we have in type the sixth edition of an investigation much sought after, namely, 'The Secular Variation of the Magnetic Declination in the United States and at some Foreign Stations.' From a small beginning in 1859 this paper has grown to be a complete depository of magnetic results available for the study of the secular change within our territory, and the author discusses most thoroughly the laws governing this mysterious movement, the cause of which is as yet entirely unknown, though in its nature it must be cosmical, since we cannot think of any adequate cause within the earth to produce, so far as we can judge, with the utmost regularity, the observed angular motion of the needle during centuries.

The deductions rest on 1,071 observations made at ninety-four stations. The earliest observations on our western coast date from the sixteenth century (Sir Francis Drake), the earliest records on the eastern coast dating from the beginning of the next century (Hudson and Champlain). In this branch of research the Survey profited by the use of the valuable collection of declinations and dips, the earliest on record, made by Prof. E. Loomis (now of Yale College), who published them in *Silliman's Journal* in 1838 and 1840, and without which our results would not possess the degree of reliability they now have. In this sixth edition, which spreads over 116 quarto pages, we have minute references to observations, together with their critical examination. The resulting secular change, illustrated by several diagrams, is expressed analytically and is also given in tabular form. The laws which so far appeared to govern this motion are stated, and embrace the whole of the area of the United States (inclusive of Alaska), and are given sufficient expansion to facilitate their connection with similar relations referring to Europe, South America, and eastern Asia.

The magnetic records brought home by the polar expeditions in command of Lieutenants Ray and Greely were placed in care of the Coast and Geodetic Survey: this material was subjected to computation and discussion, and arranged for the press. The Point Barrow work (1881–83) forms part VI. of the official publication of Lieutenant Ray's expedition (published in 1885), and the work done at Fort Conger (1881–83) under Lieutenant Greely will form Appendix No. 139 of Vol. II. of the official publication now passing through the press.

The reduction, analysis, and discussion of the automatically registered material at the magnetic observatories still await sufficient computing force to bring out the many laws and complex relations due to the ceaseless changes of the magnetic force.

The annual expenditure on account of terrestial magnetism is

small, being only about one two-hundredth part of the whole appropriation for the Survey.

Another of the subordinate branches of the Coast Survey work is the determination of the earth's density. The pendulum, being an instrument which will swing faster or slower according as the force of gravity is stronger or weaker, can be employed to measure this force. All forms of pendulums will determine variations of gravity, but different shapes are given it, depending upon the particular object in view. That approaching nearest the ideal mathematical pendulum would be a heavy ball suspended by a fine string. This form was used by Borda, and a modification of it by Bessel consisted of swinging the ball with strings of different lengths. Kater employed a form known as the invariable one, — meaning by the term 'invariable' that none of the parts of the pendulum are interchangeable, and that the instrument remains identical for experiments made at different stations. Kater's pattern is generally preferred when the object is simply a determination of the differences of the force of gravity for different places. The reversible pendulum is one having two points of suspension, which are so placed that the times of oscillation are equal, or nearly so, whether the instrument is hung in the direct or reversed position. This form is used when the object is the determination of the actual force of gravity, or in other words, how far a body will actually fall towards the earth in a given time. As the distance between the two points of suspension is equal to the length of a simple pendulum which would oscillate in the same time, the determination of the force of gravity by this method becomes a comparatively simple matter as far as theory and principle are concerned. In the practical execution of the work there are difficulties that make it one of the highest precision, and at the same time one demanding the greatest care and attention to details.

In all pendulum experiments for the determination of gravity, whether relative or absolute, it is evident that the pendulum must swing under precisely the same circumstances, or the observations must be reduced to what they would have been had they been made under the same circumstances. The principal influences bearing on the duration of an oscillation, and those which vary most from one station to another, are the changes in the rate of the timekeeper, those resulting from differences in amplitude of the oscillations, and those dependent on the temperature of the pendulum and the pressure of the surrounding atmosphere.

The first two are readily disposed of, as one is independent of the pendulum and the other is a question of simple geometrical relations. The influence of the temperature may be determined either by swinging in great ranges of temperature and noting the changes in the period of oscillation for the two conditions, or by measuring the increase of length of the pendulum for a given increase of temperature and resorting to computation for the effect of this increase of length on the time of an oscillation. The pressure correction, or at least as much of it as is dependent on the buoyancy of the atmosphere, may likewise have two independent determinations. A part of this correction comes from the influence of the air that is set in motion, and depends on its viscosity. But the whole atmospheric effect may be eliminated from the length obtained for the seconds pendulum by using a reversible pendulum whose external form is symmetrical with reference to the centre of figure. The Coast and Geodetic Survey pendulums devised by Assistant C. S. Peirce are so made. Two different lengths are also used, one yard and several metre pendulums having been made at the Coast Survey Office in 1881. These instruments have been swung in many parts of the United States, from Boston in the east to San Francisco in the west, and from Albany in the north to Key West in the south. Besides these experiments, which were nearly all made near the sea-level, comparatively speaking, many determinations have been made at higher elevations in order to study the effect of distance from the earth's centre, and the attractions of mountains and table lands lying between the station and the sea-level.

In order to connect our series of pendulum observations with similar work done in Europe and other parts of the world, several of the principal pendulum stations in Europe were occupied with a Repsold reversible pendulum, and the same was swung also at some home stations. Also the Kater invariable pendulums, brought to this country by Captain Herschel, and which had been swung in different parts of the world, were swung at several of our stations as well as in New Zealand, Australia, the Malayan Peninsula, and Japan. The Coast and Geodetic Survey has thus secured an intimate connection with pendulum research the world over.

Outside our own country the Peirce pendulums have been sent to Lady Franklin Bay with the Greely expedition in 1882, to the South Pacific Ocean with the solar eclipse expedition of 1883, and to the Hawaiian Islands at the request of their government in 1887. In this last voyage both a yard and metre pendulum were swung at an elevation of ten thousand feet, and also at two stations at the sea-level. All this foreign work was done either by an officer of the Survey or by a trained observer following the most approved home methods.

The swaying of the stand on which the pendulum rests necessitates another correction to the time of oscillation in the case of absolute determinations. This source of error has been investigated mathematically by Professor Peirce. The English have used a small inverted pendulum attached to the stand for determining this correction.

The determination of the figure of the earth is one of the objects of pendulum observations. The force with which bodies attract each other depends on the quantity of matter in them and their distance apart. Places on the earth, therefore, which have an excess of matter, either from the material being of greater volume, or of greater density, will show a corresponding increase of the force of gravity; and places near the pole, from their being nearer the centre of the earth, would be expected to show a variation in the force of gravity in the same direction. Hence gravity determinations made at different points, starting from the equator and going towards the poles, will show the relative distances from the centre, and from this, with the aid of Clairaut's theorem, the shape of the earth. This would give a general figure for the sphere. Besides this, the pendulum will determine irregularities in this figure. In general, the result of pendulum observations thus far seems to indicate that gravity is in excess at island stations and coast-lines, and in defect on mountain tops; but this last may be partially due to the sea-level being raised in the neighborhood of continents by the attraction of the land, and the former is certainly influenced by the attraction of the surrounding sea-water. At any rate mountain observations point towards the conclusion that there may be either immense subterranean caverns beneath, or that the mass may be composed of lighter material than the earth's crust generally; and it may likewise be inferred that the stratum forming the bottom of the ocean is composed of comparatively heavy matter.

There are shown in this exhibit two reversible pendulums which have been used in the observations above described. One is a Peirce reversible metre pendulum swung in the heavy wooden frame devised for it by Professor Peirce, who has found it necessary to discard metallic stands. The other is the Repsold reversible metre pendulum referred to above. It is mounted now as it was when used, except that certain parts not necessary for showing the pendulum oscillations are omitted.

ENGLISH RAILROAD SPEEDS.

IN a recent letter from Manchester, England, to the *Railroad Gazette* of this city, Mr. W. H. Booth says that so important have been the changes made in the passenger traffic of all the great English companies, and also so numerous, that 'Bradshaw,' guide to all British lines, did not appear until the 3d of July. The alterations, of course, as usual, date from July 1, and call for special notice. 'Bradshaw' is studied with especial zeal just now by old established travellers, for the numerous changes have quite overthrown their knowledge. All the three companies which conduct a traffic between London and Scotland have added new expresses or increased the speed of existing trains, and the train service between the large towns has also been greatly improved and accelerated. For some time past American superintendents of motive power, and master mechanics, have been priding themselves upon running a good second to their English colleagues, and even ven-

turing to hint that they would soon pass them. Now, however, as usual with all changes in England, the progress there has taken a great step forward, and even the lines south of London, or more properly speaking, of the Thames Valley, are waking up, and the French also have ventured to reduce the time of the Calais and Paris express some fifteen minutes.

The fastest train between London and Edinburgh has hitherto been the Great Northern, from King's Cross, and it has performed the journey of 396 miles in nine hours. This same train now performs the distance in eight hours and a half, and of this time there are twenty minutes taken up for lunch at York, so that the run is seen to be very excellent indeed. On the other hand, the Northwestern, which has hitherto done the 401 miles between London and Glasgow in ten hours, has knocked off a whole hour, and runs the distance in nine hours, at a speed of forty-four and a half miles per hour, including stoppages, which consume forty-five minutes. Hence, while running, the speed is over forty-eight and a half miles per hour. Of the distance of 401 miles, 190 are over the hills of the Lake district and the Scottish Lowlands, but are covered at the same speed, about forty-seven miles per hour. The Northwestern line has to climb to an elevation of 870 feet over Shap Fell, and the Caledonian sixteen hundred feet at Beattock, with long grades of seventy and seventy-five feet to the mile in both cases. The Midland, again, which attains an elevation of fifteen hundred feet near the head of the Eden Valley, and has a large number of severe curves and gradients, runs 423 miles between London and Glasgow in nine hours and twenty minutes. This is really a better performance than that of the Northwestern, for one of its trains runs twenty-two miles further in only twenty minutes more time. Of the sixty minutes reduction in time by the Northwestern train from Euston station, it is remarkable that the whole of it is taken out of the running time, for the stops are as frequent and as long as before.

The 250 miles between Manchester and Glasgow are completed in five hours and fifty minutes, with six stoppages.

Between Manchester and London there are run daily no fewer than forty-two trains, which maintain a speed, including stoppages, of over forty miles per hour, and as many as twenty-seven similar trains between London and Liverpool. From London to Manchester is 203½ miles, and the shortest time is four and a quarter hours, by the Great Northern, with a climb of a thousand feet, in Longdendale near Penistone. This run includes a stop of five minutes at Grantham and of four minutes at Sheffield. The time of this train is three hours and twelve minutes to Sheffield, which is 162¼ miles from London. The speed is thus close upon fifty-one miles to Sheffield, or, deducting a stop of five minutes at Grantham, over fifty-two miles per hour, and this allows nothing for the slacking off at stops and the time lost in attaining full speed, this loss being always considerable with the large-wheeled engines used in England.

These fast English expresses are by no means light trains: the Scotch expresses especially are long, fully loaded trains, and the speeds attained with regularity and punctuality as well as economically as regards fuel, ought to receive attention on this side of the Atlantic, where it is the fashion to believe or pretend to believe that English locomotives are inferior machines, and universally provided with rigid wheel base, and unprovided with either bogies or other means of axle radiation.

The incorrectness of this assumption is shown by the following facts. The three routes to Scotland are worked by the somewhat different types of locomotives owned by four English and three Scotch railways. One company, the London and Northwestern, employ a single pair of wheels in radial guides under the front end of the engine. Another, the Great Northern, use a four-wheel truck with cylindrical centre pin and no lateral motion, and the five others employ the Adams four-wheel bogie, which has practically universal motion, the centre pin being a portion of a sphere, and the lateral motion being regulated by adjustable springs instead of with links as in American trucks. Thus none of the heavy express engines running these important trains have a rigid wheel base.

Of the seven types of locomotives used, two are compound, one is outside connected, and the other four are inside connected. One has a single pair of drivers, one has four drivers but no coupling rods, being on Webb's system, and the other five have four coupled drivers.

Considerable difference of practice exists with regards to the means of enabling the carriages to pass round curves. All the routes use, more or less, six-wheel carriages, with from eighteen to twenty-one feet wheel base, the boxes having some lateral motion in the pedestals or axle guards as they are called. The standard practice of the London & Northwestern is, however, an eight-wheel carriage, the end wheels having a radial motion controlled by springs. The Midland uses American pattern six-wheeled trucks under long passenger carriages, and four-wheeled bogie, with independent semi-elliptical springs above each journal box, dispensing with the heavy equalizer and in some cases with bolster springs. Two other lines use trucks under long carriages only, and the others adhere generally to the six-wheel arrangement as being lighter and simpler, though the motion round curves is not so smooth.

A compound engine of Webb's system, and made by Beyer, Peacock & Co., of Manchester, will soon be tried upon the Pennsylvania. As many of the fastest English trains are run regularly by engines of this type, it will be of interest to note their performance on American lines. Should the engine prove a failure, the cause certainly cannot be laid to the engine in the face of the scheduled speeds in 'Bradshaw,' which are not merely speeds on paper but represent what is actually performed. Possibly the inferior quality of American coal may be found unequal to supply steam in an English fire-box, which, for the work done, is generally smaller than in America. If this is not the case, there can be no reason for failure, apart from unskilful handling. With such an example of speeds before them is it not time that American trains made faster running than they do? England is a small country, and yet the English, who work much shorter hours than the Americans do, and must necessarily spend far less time in travelling between their large cities, are not satisfied unless they travel at the very highest possible speed. They certainly waste a half hour in stoppages during a run of eight and a half hours, mainly for dining. Actually therefore, they run four hundred miles in eight hours, and so would cover the nine hundred miles from New York to Chicago in eighteen hours, if they would dine on board the train. Travelling in England is very much simpler than in America. The use of sleeping cars is hardly necessary. Every important journey in the country is performed in less than nine hours, and the majority of the long journeys do not consume five hours. Hence sleepers and dining cars are a superfluity, with which few travellers in England care to be annoyed. In the United States they are indispensable, and perhaps their use has had something to do with the slowness of American trains.

SCIENTIFIC NEWS IN WASHINGTON.

The Topographic Maps of the United States Geological Survey; what They Are and What They Show. — The Proposed National Zoological Park; its Location and the Advantages of the Site. — How the Japanese Ferment, 'Koji,' is Made.

The United States Geological Survey's Topographic Maps.

"WHAT business has the United States Geological Survey to be spending the money appropriated for its work in making topographic maps on large scales?" is a pertinent question that is often asked, and more frequently of late since the Survey, in co-operation with some of the States, is rapidly pushing forward the work of mapping the area of those particular States to completion. "Why does not Major Powell, the Director of the Survey, send out his geologists to study, arrange, and represent on a geological map the rocks and minerals of the country, and let somebody else indicate on maps the hills and valleys, the forests and streams, the roads and towns?" This question contains an implied criticism of the management of the United States Geological Survey that is heard in Congress every session, and is repeated by men both in and out of government employ who think that the Survey is overstepping the limits fixed for it by law.

This question has been answered more than once, but it has been in testimony given before a commission or a committee of Congress, that never had a popular circulation, and which, if it had, is so voluminous and mixed up that very few persons would suc-

ceed in getting any definite information from it. Preliminary, therefore, to a description of these maps, and preliminary to an enumeration of some of the practical uses which they have, the question as to the authority for making them should be answered.

It is the purpose of the Director of the United States Geological Survey to make the geological map of the United States a practically useful one. It will not only show the character, extent, and positions of the rocks that underlie the surface, in a general way, but it will aim to show them exactly where they are in nature, and their relation to the surface of the ground, so that a person in possession of one of these maps may go and find the outcrop of any particular stratum, if it has an outcrop, learning from the map whether it is at the top or on the side of a hill, or in a valley, and its relative position, not only to other strata, but to the prominent landmarks of the adjacent country. But, in order to locate the geological features of a section of country accurately, it is necessary to have an accurate map showing the topographic features of the section, and no such maps had been made until the United States Geological Survey took up the work.

The topographic maps now being made are to be the basis of the geological work. Without them the latter would be in great degree useless. The preparation of them is the necessary preliminary work to the geological survey, and, as Major Powell's bureau is authorized to make a geological map of the United States, that authority necessarily implies authority to do the necessary preliminary work.

But good topographic maps, even when made primarily to be used as the basis of a geologic survey, have an incidental value in many other ways, and it is entirely proper, it is very desirable, indeed, that they shall be utilized in every possible manner. Not a single state, except two which will be referred to later, has to-day even a fairly good map of its area. The best are inaccurate and show little or nothing of the topography. The river courses, the larger ponds and lakes, and the higher hills or mountains are approximately located upon most of them, but aside from these more prominent features they give no idea of the character of the face of the country. Where roads are laid down there is generally nothing to show whether they extend over a rolling, hilly, or flat country; and any one who should attempt to drive across the country with one of the best of these maps as a guide is pretty sure to get lost and have to inquire the way. In many of the existing maps the culture, that is the houses, with the names of their owners or occupants, and other transient features in which individuals are interested, are given with considerable detail, but many permanent natural features are omitted. The former make a map sell; the latter make it of practical use in a hundred different ways.

Several of the States, recognizing the importance of having good maps of their areas, have appropriated money for that purpose, and commissions have been appointed to supervise the work of making them. But, as it is the purpose of the United States Geological Survey to make topographic maps of the entire country as bases for its geological maps, and as it has the instruments, trained expert topographers, and an organization perfected by which maps can be made much cheaper and better than they can be made by any special force organized for that purpose, it is an obvious economy for the States to employ the Geological Survey to make these maps, even though they have to pay the entire expense of them, rather than to attempt to do it themselves.

The general government also derives a direct benefit from this co-operation. If the States do not make topographic maps of their areas the United States Geological Survey will do so for its own purposes. If the States do make the maps, but make them in their own way, they will not be uniform with those made by the Geological Survey or with each other, so that, while they may be very good maps, they will be of much less use in making a geological map than if the uniformity referred to was preserved. In fact, the United States Geological Survey would eventually have to go over the same ground and make its own maps. On the other hand, if the money appropriated by the States for map making is paid over to the Geological Survey and used as far as it will go in paying the expenses of making the maps, the cost to the general government of getting such topographic maps as it needs is reduced by the amount of the State appropriations, and the expense to the States is lessened by the amount that the general government contributes.

Three States have thus far availed themselves of the opportunity to co-operate with the United States Geological Survey in making topographic maps of their areas,— Massachusetts, New Jersey, and Rhode Island. The maps of the first two have been completed and are now in the hands of the engravers. For each State there will be a large atlas of beautiful copper-plate sheets showing with almost absolute accuracy the location of every natural feature of the country, the altitude of every point, and, by contour lines, the steepness of all hills, the positions of cities, towns, villages, and post-offices, the courses of the roads, railroads, canals, etc., and, in general, every thing that is permanent in its character as distinguished from that which is temporary, or of individual rather than general interest.

The topographers are now in the field at work upon the Rhode Island map, and it will be completed this season. The area of the State is about eleven hundred square miles, and of this about four hundred square miles has already been mapped, leaving about seven hundred square miles still to be done.

Besides the work in these three States, the United States Geological Survey has made topographic maps of the Appalachian belt extending through parts of the States of Virginia, West Virginia, North Carolina, South Carolina, Georgia, Alabama, Kentucky, and Tennessee. Work has also been done in Missouri and Kansas, and a large area in those two States has been mapped. A party has been at work for two years around Fort Smith in Arkansas, and about four thousand square miles have been mapped in Texas. Around Madison, Wis., a small area has been surveyed for the benefit of Professor Chamberlin's work on glacial geology, and an experimental start has been made in Iowa. This work has all been done by the United States Geological Survey without the co-operation of the States. Some work has also been done in the Rocky Mountain region supplemental of that of the Powell, Hayden, King, and Wheeler surveys, which was done before the United States Geological Survey was organized, but which will be utilized.

The topographic maps of the United States Geological Survey are made upon three different scales. In the first, or smallest scale, one unit of distance on the map represents 250,000 units of distance in nature, or four miles in nature is represented by one inch on the map. The second scale is twice as large as the first, or 1 to 125,000, — two miles to an inch, — and the third one-fourth as large as the first, or 1 to 62,500, — one mile to an inch. In the maps of the smallest scale an atlas sheet, when it is engraved, will represent an area included within one degree of latitude and one degree of longitude. If the second scale is used there are four atlas sheets to a degree, and when the largest scale is employed it requires sixteen atlas sheets to cover one degree of latitude and one degree of longitude. The maps of Massachusetts, Rhode Island, and New Jersey are made upon the largest scale.

The question as to the best scale for maps and the minuteness of detail that it is wise to attempt to represent has been a great deal discussed by map-makers, but no agreement has been reached. The publication scale of the United States Geological Survey maps and the size of the sheets which the topographers use in the field have necessarily no definite relation to each other. Some men do better work upon a large than upon a small sheet, but the tendency is, with every year's experience, to work nearer and nearer to the publication scale; that is, to put into the original map all that can be shown on the engraved sheet without confusion, and to omit other details.

The questions that are asked the topographers when they are in the field disclose the particular features of a map in which the people are most interested. For instance, in Rhode Island great interest is manifested in the development of water power and also in regard to the altitude of the higher hills of the State. In explanation of the frequent question whether this hill or that is not the highest in the State, it may be said that a great many of the farmers of Rhode Island are becoming more dependent upon summer boarders than upon the products of their generally sterile lands for their support, and every one whose house is on the top of a hill would like to be able to say that it is on the highest point in the State. How little was known about the relative altitudes of the

hills of Rhode Island is shown by the fact that in the report of the State census of 1885 several hills are mentioned each of which has been asserted on what was supposed at the time to have been good authority to be the highest in the State. The greatest altitude of all of these, that of Woonsocket Hill, was given as 570 feet. The United States Geological Survey engineer who has been running levels over the State found that the altitude of the road across Chopmist Hill is more than 700 feet. Chopmist Hill was not in the State census list.

The United States Geological Survey topographic maps have already been found to be of great practical use in locating roads and railroads, and in the development of the mineral resources of the country. The illustrations of this are constant and numerous. General Wilder of North Carolina was interested in a projected railroad from Charleston, S.C., to a point in North Carolina to reach which it was necessary to cross a mountainous country. After examining the maps of the region made by the United States Geological Survey he said that they were worth ten thousand dollars to his company. They showed that the route they had contemplated was impracticable, and to have ascertained that by a special survey would have cost the sum named. The Canadian Pacific Railway Company made four trial surveys before its engineers were able to select the best route across the Rocky Mountains. The cost of these trial surveys was three million dollars, a sum that would have paid for making a topographic map of the whole region upon a four mile to an inch scale, and such a map would have shown the best practicable route at a glance. As these surveys are extended over greater and greater areas their uses will multiply. The Great West has developed much of its resources in advance of the map-maker; the New South, more fortunate, will have the aid of the map-maker, and consequently will develop its mineral resources and lay out its railroads at much less expense.

A question that is constantly asked at the United States Geological Survey office is, "Have you a map of such or such an area, and if so, where can I get a copy?" The answer that has to be given, when the area referred to has been mapped, is that no provision for publishing the map has been made. The organic law of the Survey does provide for the sale of its publications, but the topographic maps are not, in law, complete work. They are only data or material for the use of the geologist. It is not necessary, in order that they shall be available for geological work, that these maps shall be engraved, and by no other method of reproduction can copies for popular use be satisfactorily made. It is to be hoped that Congress, appreciating the value to the people of these maps, will authorize them to be engraved and copies of them to be sold at cost. In cases of State co-operation provision for the reproduction and distribution of the maps is made by the legislature.

The Proposed National Zoological Park.

The Senate has added to the sundry civil appropriation bill a provision for a national zoological park on Rock Creek, in the suburbs of Washington. The site selected is one of the best for such a purpose in the country. Through the centre of it winds Rock Creek, a most picturesque little stream, from the banks of which, on either side, rise a series of beautiful hills covered with fine timber. The tops of many of these hills have already been selected for villa sites, and a great number of beautiful surburban residences have either already been built or are in contemplation. The system of street railways is to be extended from the city into this section, so that the proposed park will be easily accessible by a short and pleasant ride, while the drive to and through it will not be surpassed in beauty by any in the suburbs of any other American city.

The area of the proposed zoological park is about one hundred and twenty-one acres. About three-fourths of it is covered with forest, and although its length is only three-fourths of a mile, the course of the stream in passing through it is more than a mile and one-third. It is believed that the entire tract can be purchased for less than two hundred thousand dollars. The distance from the White House to the proposed entrance to the park is but a little more than two miles.

In the National Museum the general government has provided for the preservation of objects representing the archaeology, geology, mineralogy, and flora of the country, and its progress in the arts and sciences, and the Senate has already approved a measure providing for an additional building, which, when completed, will more than double the exhibition space now available. But the fauna of this country is becoming extinct more rapidly in many of its branches than any other of its interesting aboriginal features. Some species of animals have already disappeared from sections where they formerly were plentiful, and others are now but rarely found. No provision has ever been made for the preservation of specimens of these native animals; no provision can be made except by the government of the United States, and not even in the way now proposed if there is much longer delay. If Congress acts promptly in authorizing the establishment of a national zoological park, specimens of animals that have already become practically extinct, although they were numerous when America was first settled by Europeans, may yet be obtained, and in time the entire fauna of the country may be represented. It is hoped that the House of Representatives may agree to the moderate appropriation for this purpose proposed by the Senate.

Preparation of Japanese 'Koji.'

In response to a request from Dr. W. M. Murtrie, professor of chemistry in the University of Illinois, the State Department has obtained from Prof. C. C. Georgeson of the Imperial Japanese Agricultural College at Tokio an account of the method of preparing the peculiar ferment called 'koji.' It is made, Professor Georgeson says, both in 'sake' breweries and 'koji' factories, and one of the essential conditions of its production is that an even temperature shall be preserved in the fermenting rooms. In 'koji' factories these apartments are usually fifteen or twenty feet underground, in some sufficiently dry place, and are reached by means of a shaft, while in 'sake' breweries these chambers are frequently arranged in ordinary buildings, the walls being lined with straw mats and mud to prevent radiation.

The materials used are water, rice and 'tane' (seed or leaven). The rice is the common starchy kind known as 'uruchi.' Glutinous rice ('*mochigome*') is not used. The 'tane' is the spores of a fungus, *eurotium oryzeæ ahlb.*, and occurs as a yellow powder, which, at a certain stage of the process, is mixed with the rice. It is the substance which, in germinating on the rice grain, changes part of the starch into dextrose and dextrin, and gives it the properties of a ferment.

The rice is first thoroughly cleaned and the thin covering ('*testa*') of the seed is removed. If this is not done the liquids with which the 'koji' is mixed would be inclined to putrefy. The rice is then washed by stirring it in a tank of water till all the dust and adhering fine particles are floated off, after which it is steeped for some hours to soften the grain.

The steaming may be done in the ordinary way by means of a steam boiler, although the Japanese method is much more primitive. When this is completed the rice is spread upon straw mats to cool. When the temperature has fallen to 98° or 100° F. the 'tane' is sown upon the mass and thoroughly mixed with it. The thorough and uniform distribution of the 'tane' is more important than the exact quantity used. The amount is generally 1½ to 2 cubic centimetres per bushel of steamed rice. The 'tane' used in most factories is obtained in Osaka, but as to the manner of its production Professor Georgeson says he is not fully informed. So far as he can learn, however, since those who produce it keep their methods secret, the rice impregnated as described above will in due time mature the plant, and the spores will form on the surface of the grain as a yellow powder. When the crop is ripe, the rice is dried, spread upon paper, and then stirred or rubbed until the spores are detached by attrition and collected on the paper. The 'tane' is said to be produced chiefly in winter.

In the production of 'koji,' after the 'tane' is mixed with the rice the mass is allowed to remain in bulk eighteen or twenty hours, being simply covered with mats. The temperature of the room is not kept high at this stage. The next day the rice is distributed into shallow wooden trays, each holding about three litres, and spread in a thin layer on each. These trays are then carried to the warmest room, where the minimum temperature should not be

lower than 75° F., and here either placed on shelves or piled one on the other on the floor. In some cases the rice is sprinkled with water and left standing in baskets several hours before it is distributed on the trays. In other cases the trays are not placed in the warm room until toward evening of the second day (the day after sowing the 'tane'), and they are then left undisturbed until early in the morning of the third day. When the rice is not moistened the trays are left standing only four or five hours, when the contents of each must be thoroughly stirred by hand, which process is repeated after another four hours of rest. At this stage the fungus grows rapidly and much heat is evolved; the grain becomes opaque, assuming a fibrous texture and becoming somewhat sour in taste. After from four to ten hours the trays are emptied of their contents and the rice spread thinly on mats to cool. It is then 'koji.'

There is a loss of weight during the process of from ten to twelve per cent of the rice used. This is due to the evolution of carbonic acid, which makes the ventilation of the room necessary in order to make it possible for the men to remain in it. The usual mode of ventilation is to insert a perpendicular flue, which can be opened or closed at pleasure, extending from the ceiling to the outside air, and an inclined or horizontal flue which discharges fresh air near the floor.

ELECTRICAL SCIENCE.

A New Diffusion Photometer.

MR. J. JOLY has brought out a new photometer which is simple and sensitive. One form consists of two parallelopipeds of paraffin of equal dimensions, planed smooth so they can be laid accurately together on similar faces. Putting these together with the plane of discontinuity at right angles with the line joining the lights to be compared, the compound block is moved toward one or the other of them until the fine line of division between the two pieces almost or wholly disappears. The distances from the lights to the plane of discontinuity are now measured; and the relative intensities reckoned as inversely as the squares of the distances. In the case of lights of dissimilar colors the appearance of the photometer is no longer uniform, but that of two softly glowing substances of different colors. Even under these circumstances, if the colors are not greatly different a point of minimum distinctness of the line can be found with considerable accuracy, The greater sensitiveness of this photometer over some of the other forms used is due to the fact that we have to concentrate all of our attention on the line of junction only, not on two images at some distance apart. Instead of paraffin, glass of a transluency approaching that of paraffin may be used, and the effect may be heightened by interposing between the two pieces a sheet of silver foil. The dimensions that Mr. Joly finds best are 20 by 50 by 11 millimetres for each parallelopiped. They are laid together on two of the larger faces, the parallel external faces being ground smooth, but left unpolished. The surface under observation during the experiment is ground smooth and polished after joining the parallelopipeds. The most important points to be attended to in their construction are fineness of division line and uniformity in thickness. Should there be any difference in the translucency of the parallelopipeds a check observation might be made by turning over the photometer so that the halves change places relatively to the lights, taking the mean of the observations. This is, however, rarely necessary. This compound block is mounted in the same way as an ordinary Bunsen photometer, and the same precautions are necessary in using it.

ELECTRIC TRACTION ON THE UNDERGROUND ROADS IN LONDON. — Nowhere can electricity be more easily employed for traction work than on the underground roads that are to London what the elevated roads are to New York. The rational method of employing it is to use motors supplied from an overhead wire, the electricity being generated at stations along the lines. The objections sometimes urged against the overhead system for use on city streets cannot apply here, and there would be little doubt of the economy of the system, besides the great advantages it would possess as far as ventilation and comfort went. Instead of using a direct current, however, it is proposed to employ storage batteries on the train. The motors are to have a capacity of 600-horse power, and when one considers the difficulties that have been experienced in getting a battery of reasonable weight that will give a maximum output of ten or fifteen horse power for ordinary tramway work, it would seem that the plan is almost certain to fail. A hundred tons of battery might be sufficient, but with the initial cost of it, its deterioration, and the power that must be expended to draw it, the chances for the economical working of the system are small.

TRANSFORMERS BASED ON ELECTROSTATIC INDUCTION. — M. Doubrava has described a method of reducing currents of high potential and small quantity to those of low potential and great quantity by means of electrostatic condensers. He first charges a condenser of comparatively small capacity to a high potential, then disconnects it from his line and discharges it into a condenser of great capacity, thereby lowering the difference of potential between the coatings, and finally he discharges the large condenser into the lamp-circuit which he wishes to feed. By performing this operation fast enough a practically continuous current is obtained in the latter circuit. While the general idea of using condensers for transforming high to low potential currents is not new, and while methods have been proposed which seem as promising as that of M. Doubrava, yet his system has in it some elements of novelty. The difficulty lies in the great capacity of the condensers that will be required. Taking the charges and discharges as rapid as seems practicable; the condensers — supposing the distribution is at 200 volts — would have to have a capacity of about 1,000 micro-farads for every horse-power transformed. Now a condenser of 1000 micro-farads capacity is enormous, and would be expensive to build and too large to conveniently store. The efficiency of the system would be, probably, very high, but it would require rotating apparatus of some description, which, with the fact that house to house distribution at high potential would be dangerous, would necessitate the distribution of the low-potential currents from substations. When one tries to imagine a sub-station distributing 500-horse power, with a condenser of a capacity of 500,000 micro-farads, the system will seem a doubtful one.

ALLOYS FOR ELECTRICAL RESISTANCES WITH NO TEMPERATURE CO-EFFICIENT. — Mr. Edward Weston has discovered an alloy whose specific resistance is high and whose resistance is not affected by temperature changes within ordinary limits. This is valuable for electrical resistances, and will doubtless have an extended use. The alloy is a mixture of copper and manganese. It may be made from copper and ferro-manganese in the proportions, copper 70 parts, ferro-manganese 30 parts. A still more curious alloy is made from copper 65 parts, ferro-manganese 25 to 30 parts, nickel $2\frac{1}{2}$ parts. This possesses the remarkable property of decreasing in resistance as its temperature rises, a peculiarity heretofore ascribed to carbon and electrolytes only. This last alloy can be used with ordinary copper or German silver coils in such proportion as to cause the total temperature co-efficient to be zero. It is to be hoped that these substances will be carefully studied and their properties at high and low temperatures determined.

CHEMICAL ACTION IN A MAGNETIC FIELD. — Since 1881, when Professor Remsen discovered that the deposition of iron was affected by a strong magnetic field, experiments have been tried to determine the nature of the effect of magnetism on chemical action. The latest and most satisfactory contribution on the subject is that of Prof. H. A. Rowland and L. Bell, in the current number of the *American Journal of Science.* Their general method was to take two pieces of the metal to be experimented on, put them in circuit with a galvanometer, and immerse them in an electrolyte between the poles of a powerful magnet. The two pieces were covered with wax except at two opposite points, where they were bare, and by changing the shapes of the uncovered portions the condition of their surfaces with respect to the rate of change of magnetic force could be varied. For instance, in the first experiment that was tried pieces of iron were immersed in dilute nitric acid. One of the bare surfaces was flat, the other filed to a sharp point. If there was no deflection of the galvanometer when the circuit of the magnet was made, there was a sharp throw immediately on making the circuit, the needle then gradually returning to zero and going past to the other side. The throw was in a direction as if the sharp point was copper and the flat surface zinc. When the point was

filed off, there was no throw. Thirty substances were tested as electrolytes. They in general showed the above phenomena, excepting that the acids which evolve hydrogen when electrolyzed showed it very feebly. Experimenting to find the cause of the gradual reversal of the deflection after the first throw, it was found that any agitation of the liquid produces the same effect, and that when diffusion was prevented, by using fine sand in the vessel or by using gelatine with the solutions, the first throw only remained. The small effect with the hydrogen-evolving acids is probably due to the mechanical protection of the point by the bubbles of gas. Cobalt and nickel were tried and found to give similar effects but smaller. From their experiments the authors come to the conclusion that the particles of magnetic material on the plates are governed by the general laws of magnetic attraction and are held in place against chemical action as they would be against a mechanical force. The rate of change of force at a point is, of course, greater than that on a plane surface, hence the metal on the point is to some extent protected against chemical action, and acts as the electro-negative metal in the circuit. The general rule stated is as follows: When the magnetic metals are exposed to chemical action in a magnetic field, such action is decreased or arrested at any points where the rate of variation of the square of the magnetic force tends to a maximum. The authors criticise a paper on the same subject by Professor Nichols of Cornell, whose results are directly opposite to their own, as far as the two experiments touch. They claim that besides giving no explanation of or drawing any deduction from his results, he has in some cases mistaken disturbances for the real phenomena. The paper seems to explain the phenomena simply and naturally without the help of new relations or hypotheses.

BOOK-REVIEWS.

L'art et la Poésie chez l'enfant. By BERNARD PEREZ. Paris, Ballière. 8°.

THE English translation of Perez's 'First Three Years of Childhood' has familiarized the English-reading public with the general plan of work and method of treatment of this French psychologist and educator. M. Perez is imbued with the idea that the unfoldment of mental processes that goes on in every child and is so often the subject of literary effort can yield material for the scientific study of an important chapter in psychology. This psychogenesis in part changes its character with the relative importance of the natural and the artificial elements in the child's education, with the nature of the civilization that forms its environment, with hereditary and individual characteristics. These varying conditions affect differently the various psychological elements that go to the making of a human being, and make necessary different methods of study. In the chapter of 'Infant Psychology' that M. Perez now brings to notice, these varying conditions are of supreme importance; so much so that it seems impossible in some respects to describe the artistic efforts of children, but only of certain children. Nevertheless the path of progress is in so many respects similar, and the directions of artistic interest so unchanging in spite of national and other influences, that one feels something generic even if vague to be at the basis of it all. Again, that close analogy between the development of the individual and that of the race does not lose its application here. It is true that primitive art is far from all being alike, that the art of civilization of which it was the predecessor is no less variable; but from a psychologic point of view the development is generically alike in all cases. For example, we find that the excessive and gaudy decoration of the body is displayed by savages and young children; we find them preferring the same loud, boisterous airs in music, and equally lacking in a sense of the beauties of nature. We see, too, how the subject of serious use and adornment in one stage of civilization degenerates into a toy for the children of the succeeding stage; witness the drum, and the bow and arrow.

A survey of the many paths along which children find their way to the pleasures of art can be most easily attained by a *résumé* of the chapters of the volume before us. In the first chapter are treated the many forms of personal decoration visible in the toilet. We know how soon a child takes an interest in its costume how for girls especially the doll is valuable because it is a dressable article; and has not Lotze said that in the exaltation of the ego that is produced by the donning of a new dress is the root of self-consciousness? Taste in this direction is seldom good at first, but it takes its character so entirely from the environment that the psychologist can do little more than record the shifting of interest from one point to another that proceeds as the child matures. In the feeling for the beauties of nature, — the emotions inspired by the graceful, the sublime, the pleasures that flowers and scenery bring, — we have a higher and a later form of artistic interest. M. Perez describes very pleasantly, even if at times prolixly, the growth of these sentiments in different children of his own acquaintance, and records the corresponding descriptions in the autobiographies of eminent men and women. On the artificial side we have the growth of the social instincts, the art of making oneself agreeable, politeness, coquetry, and so on. In France at least this seems to develop precociously early, but the social position of the family must everywhere be the chief factor in its culture or neglect. Passing to the fine arts proper, music is doubtless to be accorded the foremost rank. We know that the most wonderful instances of precocious talent are to be found amongst musicians, and this is in many cases the first artistic pleasure that the child has. The human voice is a source of much pleasure to the child. The distinction between the soothing and the exciting forms of music is soon appreciated. The educational value of rhythm is recognized by all kindergartners. The many decorations of bones, of rocks, of pottery, by primitive peoples are not unlike the first scratches of a child. The things most frequently delineated are quite alike. Given a child, a lead pencil, and some paper, and the result can be predicted, with due allowance to the nationality and other circumstances of the child.

The play instinct is a very potent factor in the growth of artistic taste; performing on a musical instrument as well as acting still go by the name of 'playing.' Foreign personalities are so real to the child, his vivid imagination so easily assimilates them, that 'pretence,' acting, is a common and an early childish trait. The doll is the central figure about which the most thrilling dramas are composed and enacted; to the boy the putting on of a paper helmet and a wooden sword is enough to make him a soldier in thought and deed. Children act to court admiration, and with a normally weak distinction between fact and fiction goes a fondness for acting out what has originated in the realm of the imagination. Literary art is the latest of all acquisitions; but the first letters of a child, though lacking all merit, have a deep interest to the psychologist. To each of these topics M. Perez devotes a full chapter, and succeeds in producing a book which, though not in the strictest sense scientific and certainly not exhaustive or final, is none the less a worthy contribution to an interesting chapter of 'infant psychology.'

NOTES AND NEWS.

JAMES STEVENSON, late executive officer of the United States Geological Survey, died at the Gilsey House, New York, July 25. He was born in 1840, at Maysville, Ky. A more extended notice will appear next week.

— The buildings for the Paris Exhibition have made great progress during the last five or six weeks. According to the Journal of the Society of Arts, the large machinery hall at the south end of the Champs de Mars is now considerably more than half finished, and will probably be completed in another six weeks or two months. Considerable progress has been made with the fine art galleries; but, as they were not commenced until recently, they are not nearly so far advanced as the other parts of the building. The same remark applies to the other parts of the building for the classes included under the term 'liberal arts,' on the other side of the grounds. In this last-named building it is proposed to place a retrospective collection illustrating the progress of the arts and industries from the very earliest period. On the Esplanade des Invalides, the construction of the various small buildings with which it is to be filled has been commenced. This work has been deferred as late as possible, in order not to deprive the regiments quartered in that part of Paris of their remaining drill ground for

a longer period than was absolutely necessary. The roofs and ironwork of the long range of galleries extending along the Quai d'Orsay, and connecting the Champs de Mars with the Esplanade des Invalides, are now nearly all up. The side walls of these buildings have also been constructed for a considerable portion of their length, so that this part also of the Exhibition will be finished at no very distant date. The tower which will form so conspicuous a feature of the Exhibition has now reached about half its height. The two lower stories are now completed. The first one, forming the base, extends over a considerable area, and resembles in appearance a huge, four-legged table or stand. Its height is about 250 feet, or a quarter of the whole. On the top of this is placed the second story, of about 200 feet high; and from this second story springs the tapering column of between 500 and 600 feet in height. The point now reached is the summit of the second story. Access is obtained by means of an iron staircase built into the framing of the tower; but the guides in which the lifts will work are already in place, and when the tower is finished, the various stages will of course be reached by means of these lifts. The foundations are sunk a great depth into the ground, which at this place — close to the bank of the Seine — is less suited for bearing a weight such as a tower than the limestone rock which underlies the greater part of Paris. Great precautions have been taken to render the tower safe from lightning. It forms, of course, a conductor in itself, but, to insure proper connection with the earth, at each corner a large tube has been sunk a considerable distance into the soil, and these tubes it is proposed to keep full of water. Good electrical connection is made between the tubes and the framework of the tower itself. It remains to be seen whether a building of this enormous height will carry off electricity safely in consequence of its excellent conducting powers, or whether it might not suffer from a shock of more than usual violence. The site is certainly ill-chosen to enable the tower to make the most of its height, since it is on some of the lowest ground in Paris, and in spite of the enormous height of the building itself, at the present time, its top is now only on a level with the summit of the towers of the Trocadero Palace, a building which, though much inferior in size, stands on the high ground on the other side of the Seine. The French executive report favorably as to the exhibits which they expect to receive from foreign countries. Considerable sums have been voted, among others, by various of the South American States, as well as by the United States, and by Belgium. The Spanish government, though not officially represented, has voted a large sum towards the Exhibition, and it is said that the unofficial committees in various of the European States are most of them successful in securing a representation of their several countries.

— Augusta, Ga., the largest cotton manufacturing centre in the South, is prominent among Southern cities this year, as the site of the Augusta National Exposition, to take place Oct. 10 to Nov. 17, 1888. No outside aid has been asked, and no government appropriation been made. The project is a conspicuous and commendable one in this respect. The Exposition aims to be national in scope. Many of the largest manufacturers North and West will be represented, and an extensive government display from all the executive departments and branches of the consular service are already secured. But the most complete representation will be secured of all the Southern industries and of the development of the resources of fields, forests, and mines that has taken place in the last ten years.

— The International Congress of 'Americanists' will hold its seventh session in Berlin from October 2 to 5 next. The organizing committee has just issued the programme. The first day will be devoted to questions relating to the discovery of the New World, to the history of America before the time of Columbus, and to American geology; the second to archæology; the third to anthropology and ethnography; the fourth to philology and palæography.

— On July 9 the atmosphere in the English Channel became so rarefied that objects could be seen with extraordinary distinctness at a distance of between thirty and forty miles from Dover and Folkestone. *Nature* says that the lighthouse at Cape Grisnez, Calais, and the dome of the Cathedral, and Napoleon's Column at Boulogne could be distinctly seen with the naked eye, and every prominent object could be picked out along the French coast. The distance from Dover to Boulogne as the crew flies is twenty-eight miles, and the column is about two miles further inland.

— We learn from *Nature* that at the next meeting of the British Association there will be a discussion in Section D on the vexed question of the formation of coral reefs. The discussion will be opened by Dr. Sydney J. Hickson.

— *Nature* states that the meeting which will shortly be held in Paris for the study of tuberculosis, under Professor Chauveau's presidency, promises to be very interesting and successful.

— The German ethnological and geographical expedition to the headwaters of the Xingu under the direction of Dr. Karl von den Steinen was expected in Rio de Janeiro early in July.

— The Sociedade de Geographia de Rio de Janeiro proposes to hold in September an exposition of geographical works relating to South America, for which the co-operation of nearly all the South American States has already been promised.

— Messrs. Ticknor & Co. announce for publication, August 4, 'A History of Presidential Elections,' by Edward Stanwood; new and enlarged edition: and 'Newspaper Libel, a Hand-book for the Press,' by Samuel Merrill, of the staff of the *Boston Globe*, and member of the bar of Massachusetts and of New York. —— Lee & Shepard have in preparation 'Chips from Educational Workshops of Europe,' by Prof. L. R. Klemm; and 'Zoölogy Teaching for Beginners,' by W. P. Manton. —— G. P. Putnam's Sons have just ready two books for the student of political economy and history. The first of these is entitled 'The Tariff History of the United States,' consisting of various essays by F. W. Taussig, which have already appeared in magazines or in book-form, aud thus united present an almost complete history of tariff legislation from 1789 to 1887. The other is 'Industrial Liberty,' by John M. Bonham, who aims to keep in view the principles rather than the statistics of his subject, and makes an analysis of the salient political and industrial evils of our time. —— Little, Brown & Co. have now ready 'The Origin of Species by Means of Natural Selection; or, the Preservation of Favored Races in the Struggle for Life,' by Charles Darwin, sixth edition, in new large type with additions and corrections. —— E. & F. N. Spon, New York, announce *The Marine Engineer*, a monthly journal of marine engineering, shipbuilding, and river navigation; subscription, $1.75: also, 'Crystal Models,' by John Gorman. Compared with others, the advantages resulting from this method become most strikingly apparent. The models are built up into form in a few seconds, and it is worthy of notice that, owing to the plaiting process being well-nigh instinctive, the manipulations after a short trial become almost automatic. The forms require no sticking at the edges.

— The Senate has amended the sundry civil appropriation bill by adding a grant of $250,000 to pay the expenses of investigating the extent to which the arid region of the United States can be redeemed by irrigation. The proposed scope and extent of this investigation was fully explained in *Science* a few weeks ago.

— The United States Senate has voted to pay to the widow of the late Prof. Spencer F. Baird $50,000 as compensation for his services as United States Fish Commissioner.

— It is proposed to celebrate in the winter of 1889–90 the sixth centennial of the foundation of the University of Montpelier.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

A Standard Thermometric Scale.

AT its session last October the International Committee of Weights and Measures passed a resolution establishing a standard thermometric scale for the use of the International Weights and

Measures Service. As this is the result of the thermometric studies pursued at the International Bureau for several years, it seems desirable to give it a wider publicity than is offered by the publications of that bureau alone, from which these statements have been collected by me.

The standard scale adopted is, by the wording of the resolution "the centigrade scale of the hydrogen thermometer, having for its fixed points the temperature of melting ice (0°) and that of steam (100°) of water boiling under a standard atmospheric pressure. The hydrogen being taken under a manometric pressure of 1 metre of mercury, i.e., $\frac{1000}{760} = 1.3158$ times the standard atmospheric pressure." The standard atmospheric pressure is that exerted by a column of mercury (density = 13.596) 760 millimetres long at 0° C., at the mean sea-level in latitude 45°. An increase of pressure of one atmosphere lowers the melting point of ice about 0°.008.

All the thermometers used at the bureau are made of the same kind of glass, the composition of which was found by chemical analysis to be —

	Stem.	Bulb.
Silica	71.45	71.52
Sulphuric acid (SO_3)	0.74	0.72
Chlorine	traces	traces
Aluminum	1.26	1.57
Peroxide of iron	0.29	0.22
Lime	14.52	14.55
Soda	11.17	10.81
Potassa	0.30	0.37
Magnesia	traces	traces
Protoxide of manganese	traces	traces
	99.73	99.76

The exclusive use of this glass has several advantages.

1. The changes of the zero point are relatively very small, and its depression due to increase of temperature is practically a rectilinear function of the latter within the limits — 10° + 100°.

2. The thermometers are comparable among themselves, and it was found practicable to establish a general formula for reducing their indications to the standard hydrogen scale. A table of corrections based on this formula is given below, but of course it is applicable only to thermometers of this kind of glass. The reduction of the indications of mercurial thermometers to a gas thermometer depends on the kind of gas used and on the glass of which the mercurial thermometer is composed.

T hydrogen = *T* mercury + correction.

T m	− 20°	− 10°	0	+ 10°	+ 20°	+ 30°	+ 40°
Corr.	+ 0°.172	+ 0°.073	0.000	− 0°.052	− 0°.085	− 0°.102	− 0.107

T m	+ 50°	+ 60°	+ 70°	+ 80°	+ 90°	+ 100°
Corr.	− 0°.103	− 0°.090	− 0°.072	− 0°.050	− 0°.026	0.000

O. H. TITTMANN.

Washington, D.C., July 27.

Turner's Explorations in Alaska.

IT is with no small degree of satisfaction that naturalists are regarding the publications that are appearing from time to time from the office of the Chief Signal Officer of the Army at Washington, referring, as we do more particularly, to the reports made under the auspices of that office by the Alaskan explorers. The last one of these, very recently issued, is now before us, and presents in an admirable manner the results accomplished in that region by Mr. Lucien M. Turner, during the years 1874 to 1881, who carried on his explorations there under the direction of the Chief Signal Officer, and in connection with the National Museum.

Issued in the usual Government form, this quarto volume of some 225 pages, with its twenty-six plates, makes a very handsome work. It has been entitled 'Contributions to the Natural History of Alaska,' and is the second of the series, — its author dividing its contents into six parts for treatment. Of these, Part I. presents a very short and concise general description of the regions explored, and we learn that Mr. Turner was at various times stationed at Saint Michael's, Unalashka, the islands of Saint Paul and Atkha, at Attu, and many other points of interest. Part II., occupying about forty pages of the work, is devoted to meteorological observations, and presents in a fairly-well digested manner, the author's labors in this direction, and it is needless to add that the data here collated are not only of interest but of great scientific value. In Parts III.–VI., inclusive, the plants, fishes, birds, and mammals are dealt with, and in a very thorough manner when we consider many of the difficulties the author was obliged to overcome. Perhaps the botany of the region gained the least at Mr. Turner's hands, and it consists simply of his field-notes, added to Rothrock's list of 1867, the author stating "in this connection that of all great difficulties the most troublesome was to preserve the plants after I had collected them. The constant moisture of the climate has frequently ruined my entire collection of a summer's work. All that remained after supposing the plants were sufficiently dried would be a mass of mould and dry edges of paper, this being apparently done in less than forty-eight hours' time."

A frog (*Rana sylvatica ?*) was the only reptile collected ; and at Fort Yukon, just within the Arctic circle, this species is reported to be quite plentiful. Some excellent work was accomplished in ichthyology, and a number of species added, new to science, and several rare forms collected. Fourteen beautiful plates of fish are given, and one of a lamprey (*A. aureus*), and it would be not easy to overestimate the interesting and valuable field-notes here presented. Habits, uses, geographical ranges, and other matters, are treated with distinguished ability, and in this, much is due to the assistance of Dr. Bean of the Smithsonian Institution.

What we have just said in reference to the ichthyological part, applies with more than equal force to the work done in ornithology ; and to state the fact that no less than ten elegantly colored plates of birds by Robert and John L. Ridgway are given, is equivalent to saying to ornithologists and others, who may not yet have seen the work, that a feast for their eyes is still before them. The whiskered auklet (*S. pygmæus*) is figured in full breeding plumage ; Turner's ptarmigan, male and female, are both given ; excellent figures of the Lapp and Hawk owls, and others of special interest. Through the published field-notes much has been added to our knowledge of the habits of many of these arctic bird forms.

No mammals, unfortunately, are figured, and this part of the report has evidently not received the attention it so justly deserves, and in speaking of Cooper's shrew, our author evidently confuses that diminutive insectivore with the rodents. The volume is completed by a very full and useful index, and Mr. Turner is to be congratulated, not only upon the appearance of his work, but upon the successful termination of his explorations and labors.

Another volume by the same author is promised soon by the Signal Office, also one from Mr. E. W. Nelson, upon the same region ; and finally General Greely's own report upon the Lady Franklin Bay Expedition, which will be looked for with very general interest.

It is to be hoped that the government will appreciate more and more such works and the reports thereon, and be induced to aid and encourage them as much as possible.

R. W. SHUFELDT.

Fort Wingate, N.Mex., July 22.

The Use of the Microscope as a Practical Test for Oleomargarine.

THE act passed by Congress entitled "An Act defining butter, also imposing a tax upon and regulating the manufacture, sale, importation, and exportation of oleomargarine," approved August 2, 1886, commonly known as the 'oleomargarine law,' makes it the duty of the Commissioner of Internal Revenue to prescribe all needful regulations for carrying it into effect.

From the 1st of November, 1886, when the law first went into effect, to October, 1887, one hundred and thirty-one samples of substance supposed to be oleomargarine were submitted for the decision of the commissioner under sections 14 and 15 of this act, twenty-one of which proved on analysis to be oleomargarine, and one hundred and ten were found to be butter. Most of these latter were old and rancid. The very prevalent idea that rancidity is the most characteristic property of oleomargarine may account for the

large number of samples of rancid butter seized by the Internal Revenue officers. It seems hardly necessary to say that oleomargarine, owing to its containing a comparatively small amount of the volatile and easily decomposable glycerides, keeps in a 'sweet' condition for a much longer time than butter.

Any instrument that can be placed in the hands of those officers who are charged with the enforcement of the law, whereby they can readily distinguish between the natural and artificial product, would be very desirable.

The difference between fresh, genuine, unmelted butter and oleomargarine, which is always made in whole or in part of melted fats, can be readily and clearly detected by a microscope with the aid of polarized light, and with or without the use of a selenite plate to color the field of vision. It is true that genuine butters are sometimes accidentally melted, so that while the presence of melted fats is not a sure indication that the article is oleomargarine, their entire absence in the article found in the markets removed from the place of manufacture is a very strong indication that it is butter.

The use of the microscope for the purpose of observing the presence of melted fats in a fresh sample was first brought to the attention of chemists in 1873, in an article on butter, by Dr. I. Campbell Brown, from the 'Liverpool and Manchester Medical and Surgical Reports, 1873,' republished in the *Chemical News*, vol. 28, p. 1, July 4, 1873. Such inspection can be readily performed without previous preparation of the sample, and a large number of samples can be examined in a short time.

The expense of large instruments with the necessary attachments, as usually made for laboratories, rendered them unsuitable for use by local officers in the markets or stores in which butter and oleomargarine are sold. In December last I came across a convenient and cheap form of microscope, to which under my directions the proper polarizing attachments were added. Owing to delays of the manufacturers a sufficient number of the instruments was not secured till last April. These were placed in the hands of the collectors of internal revenue with full directions for use, etc.

The instrument consists, first, of a large bell-shaped base, having at its mouth a silvered mirror acted upon by a spring, and at its apex a tube fitted with a tightening ring; second, a draw-tube, working in the tube which forms the upper part of the base, containing a good Huyghenian eye-piece, and at its other end a ring to which the analyzer and objective, one-half inch, may be screwed; and, third, the polarizer, fitted with a small condensing lens, and provided with a milled head whereby it can be rotated, is attached, by suitable means, to the mouth of the base. For convenience in focusing, marks are placed on the draw-tube, giving the approximate focus for ordinary thickness of objects.

The instrument is carried in a small wooden box eight inches long by five inches wide and deep, containing a number of glass slides and covers, and having pasted on the inside of the box-cover photo-lithographs of a fresh sample of oleomargarine and of butterine viewed under polarized light, — 'butterine' being the trade name for the product consisting principally of lard with from ten to twenty-five per cent of creamery butter. The box is fitted with a handle.

A small portion of the fresh sample taken from the inside of the mass — to avoid crystals of salt and accidental melting of the outside of the sample — with the point of a penknife is placed on the middle of a glass slide and covered. The gentle pressure of the blunt end of a pencil spreads the sample out to make it sufficiently translucent. On looking through the instrument, at the prepared slide, held towards the direct light from a window, or a gas or lamp flame placed within a short distance, a sharp focus is quickly obtained, and on rotating the polarizer until the field is dark the presence of melted fats will be readily recognized by the bright white particles with which the whole field is illuminated. But where nothing is seen except the characteristic globules, the granular masses of curd, and the cubical crystals of salt, even when the polarizer is turned so that the field passes from the darkest to the lightest, the sample can at once be passed as genuine butter however rancid to the taste or smell it may be.

Boiled or 'ladle-packed' butter, made from old rancid butters, melted and churned with a small quantity of milk, and very rancid butter may sometimes be mistaken for oleomargarine, but by having a slide of oleomargarine or butterine ready for comparison, the difference is easily perceived. The hard fats, palmitin and stearin, exist in a state of solution in the globules of a fresh sample of butter and in the fats of living animals. Upon being melted and cooled these hard fats separate out in the form of acicular crystals which polarize light, owing to their being double-refracting bodies.

In the latter part of April I was instructed to proceed to Philadelphia and New York and assist the local revenue officers in the examination of samples of butter collected in those cities. This investigation was afterwards extended to other cities in May and Juue, and samples of all grades of butter handled by retail butter dealers were collected and examined, the object being to ascertain to what extent and by whom oleomargarine was sold without complying with the law.

The principal cities and towns in New York and Pennsylvania, and the cities of Baltimore, Washington, Hartford, and New Haven, were visited, and the samples examined by the revenue agents connected with those districts.

The method of procedure was generally as follows. On a certain day all the division deputy collectors in the city and vicinity in which the examination was to be made were detailed with instructions to visit the stores of all, if possible, retail dealers in butter, except those who had paid the special tax as dealers in oleomargarine, and to obtain a sample of each grade of butter dealt in. For this purpose each deputy was furnished with a wooden box, containing a gross of half-ounce specimen tubes, with the necessary number of gummed labels and blank forms for noting address, etc., of the dealers visited. At the end of the day the samples collected were brought to the office and placed in an ice-chest. From two to three days were devoted to this canvass. The samples were examined as soon as possible after they were received, and any specimen found showing the presence of melted fats was at once thoroughly investigated and the dealer's store visited and the goods detained, etc. Most of these cases proved on investigation that the so-called butter had been bought from a regular oleomargarine dealer or received direct from the factory.

The following table shows the number of samples of butters that have been examined in the different cities named and the number found to be oleomargarine.

Locality.	No. of Samples.	Representing Stock of Dealers.	Oleomargarine.
Philadelphia, Penn	656	288	2
Brooklyn, N.Y.	632	346	5
New York, N.Y	2998	1862	3
Jersey City, N.J.	234	145	2
Newark, N.J	280	175	1
Paterson, N.J	122	64	7
Hoboken, N.J	84	49	0
Elizabeth, N.J	103	77	1
Boston, Mass.	1181	595	2
Lowell, Mass	59	19	4
Salem, Mass	57	28	0
Cincinnati, O	651	424	6
Indianapolis, Ind	233	152	2
Chicago, Ill	719	346	2
Milwaukee, Wis	574	362	0
Baltimore, Md.	228	141	1
Washington, D.C	149	89	0
Four towns, Conn	822	478	1
Eighteen towns, Penn	599	456	19
Eleven towns, N.Y	596	426	0

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FRIDAY, AUGUST 10, 1888.

WHILE THE LACK of reliable information prevents us from gaining an understanding of Stanley's fate and the ultimate objects of his expedition, news has been received as to the events in Khartum. In May two messengers arrived in Cairo, carrying brief notes from Slatin Bey and several other European captives of the Mahdi. The handwriting of the writers was recognized by their friends, so that there can be no doubt as to their being genuine. The fate of the captives is pitiful. Only the missionaries are at liberty, and they are allowed to make a living by selling boiled beans in the streets of Khartum. Lupton Bey, formerly governor of the province Bahr-el-Gazel, was made to work in the armory like a common Arab. Recently he has been enployed in the mint of the Mahdi. Slatin Bey is made the Mahdi's runner, and has to hold his stirrup. Others are imprisoned, and the Mahdi threatens to execute them. The messengers describe the state of affairs in the Mahdi's province as miserable. The inhabitants of Khartum are said to be starving, and there is a great want of clothing and of money. Discord prevails between the followers of the Mahdi and several chiefs. One of the latter recently tried to gain his independence, but as the Mahdi's party was more numerous he submitted. Although a formal peace was made, the Mahdi made the chief a prisoner and had him hanged. The messenger says that a force of five hundred men of Turkish or Egyptian troops approaching from Wadi Halfa would be able to destroy the Mahdi's power. The tribes of the Sudan are discontented with his rule, and after a short time he would find himself deserted by everybody, a few fanatics excepted. It is considered impossible to ransom the prisoners, as caravans conveying money or goods would be robbed and murdered before arriving in Khartum. Last year a sheik of Berber offered to re-open the trade between Khartum and Egypt. Although the Mahdi was not unwilling to accept the offer, his council rejected it. This news is considered reliable, and shows the difficulties which would be encountered in an attempt to liberate the unfortunate captives. Various letters of Emin Pacha confirm these reports, for he describes the effect of the despotic rule of the Mahdi about in the same way. In how far, however, the subjected tribes would be ready to assist in an attack upon the Mahdi appears doubtful, as we might else expect that they would join Emin, whose difficulties seem to be comparatively great. From recent reports it would seem that the Mahdi is contemplating a new attack upon the Equatorial Province, and that Emin is going northward to meet him. This news must be received with due reserve, as it does not agree with former letters of Emin and the apparent decline of the Mahdi's power. The despatch says, "Two native messengers who were captured from an earlier expedition by tribes in the Uganda district, bordering on the Albert Nyanza, and who escaped from their captors about the beginning of April, have just arrived here. They report that Emin Bey was in a situation of great difficulty. Provisions were scarce, and difficult to procure, and his troops were beginning to be discouraged. On April 4 Emin received a summons from the Mahdi, dated Khartum, calling on him to surrender and to disband his troops, the Mahdi threatening to attack if Emin refused." It will be remembered that Emin kept up friendly relations with Uganda and Unyoro up to the end of last year, and that he was able to purchase supplies in Uganda. In November, 1887, he sent letters from the southern part of Lake Albert Nyanza, and stated that he was extending the limits of his province southward. Since the unexpected retreat of the Mahdi during the great war in the Sudan, he has not been molested by serious attacks from the north.

AT LAST THERE IS REASON to hope that the publications of the Geological Survey will be printed. There are now in the hands of the public printer more than forty volumes prepared by the Geological Survey and the Bureau of Ethnology. Among these are the annual reports of the Geological Survey for 1886 and 1887. The 'copy' of that of 1888 is also nearly ready. The Government Printing-Office is full of work from all of the departments, and which has been ordered by Congress, and, as a rule, it is left to the discretion of the public printer as to the order in which the work shall be done. The work of the Geological Survey and Bureau of Ethnology has generally been postponed. The appropriation for the printing of the publications of these two offices for the present fiscal year has been made a specific one: it cannot be used for any thing else. This will cause the public printer to do the work in order to get the money. Provision has been made for the printing of fifteen thousand extra copies of the annual reports of the Geological Survey, and six thousand copies of the bulletins of the Bureau of Ethnology for last year and this. The prompt issue of the publications of these two offices is certain to make them more popular, and to commend them more strongly to Congress for liberal support. They have gone on in the past, year after year, expending large sums of money, and making very little show in the way of printed matter in return for it. But this has not been the fault of Director Powell or of his assistants. They have prepared a great mass of matter, but the public printer has allowed it to accumulate in his office without putting it into type. It is now expected that the arrears of this work will be brought up during the coming year. The volumes that will appear during the next twelve months contain a great fund of popular and scientific matter.

THE APPROPRIATION OF $250,000 for the purpose of investigating the extent to which the arid region of the United States can be redeemed by irrigation, and the segregation of the irrigable lands, and for the selection of sites for reservoirs and other hydraulic works necessary for the storage and utilization of water for irrigation, and to make the necessary maps, which was attached to the sundry civil appropriation bill by the Senate, will be agreed to by the House. A careful canvass of the members shows that a sufficient number will vote for it, whether the committee report favorably or otherwise upon it. In authorizing the beginning of this important work, the government enters upon an enterprise of greater magnitude than any of the kind it has ever engaged in. Director Powell of the Geological Survey has estimated, that, of the arid region, now not susceptible of cultivation, fifteen per cent, or 150,000 square miles, or an area exceeding that of one-half the land now cultivated in the United States, may be redeemed. At thirty dollars an acre, which is a low estimate of the value of the rich lands of the West when plentifully supplied with water, this land, which is now worth almost nothing, would have a value of $2,880,000,000. By comparison the building of the Pacific Railroad sinks almost into insignificance as a means of adding to the wealth of the nation.

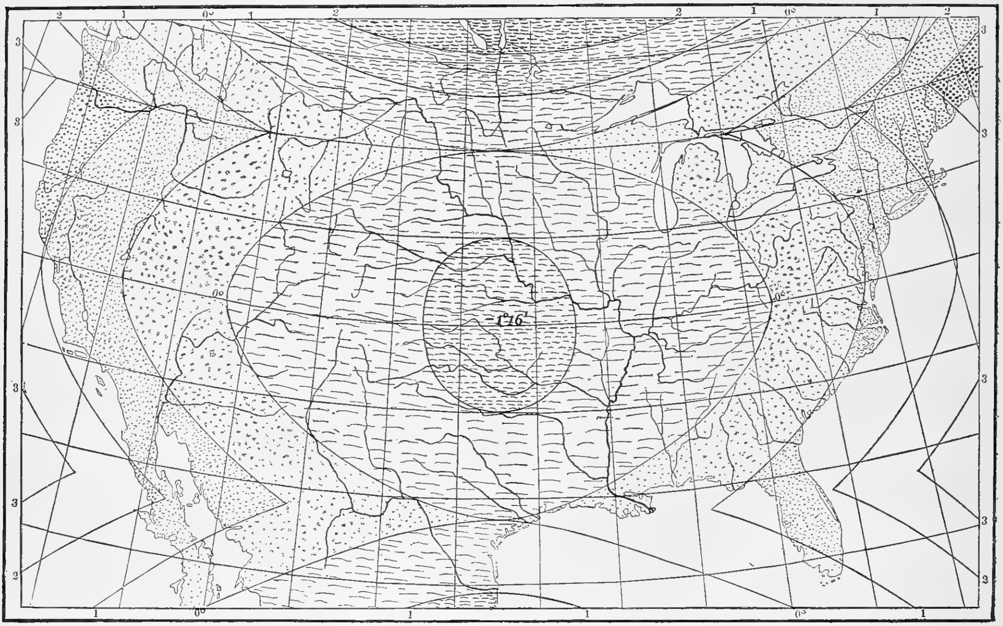
THE CENSUS MAPS OF THE UNITED STATES.

As the time is approaching for the Eleventh Census of the United States, the question whether the maps used for the purposes of the Tenth Census are satisfactory or not becomes impor-

tant and interesting. The making of a general map of the United States offers peculiar difficulties on account of the enormous size of the territory they occupy, which is so large that the curvature of the earth's surface has a very appreciable influence upon the map. This will be better understood by the fact that a circle circumscribed about the country cuts off a section of the globe of a little more than 42° aperture, its centre being situated north of Omaha. It is impossible to make a single map of the United States which in all its parts is an exact likeness of the country as it exists on the globe: therefore it is the task of the map-maker to find that method of projecting the country upon a flat piece of paper that results in alterations which are as slight as possible, and that agree best with the special object of the map.

We will consider in how far the existing maps satisfy this demand. On the accompanying map the polyconic projection of the Coast Survey which is in general use is shown in red. The lines of latitude and longitude are obtained in the following way. The portion of the globe situated between two parallels that are very close together may be considered as part of a cone the apex of which lies on the axis of the earth. By developing this cone, the zone assumes the shape of a portion of a circular ring. One zone after another is thus developed. As the side of the cone varies according to the latitude of the zone, the rings do not exactly join each other; but this is remedied by enlarging the lengths of the meridians so as to fill up the gap. It will easily be understood that by this process those parts of the map lying far away from the central meridian will become distorted and too large. We will first study the enlargement of surfaces. On our map the lines on which the enlargement amounts to 1, 2, 3, 4, 5, and 6 per cent are indicated by heavy lines. Thus it will be seen, that while, in measuring a surface in the central points of the United States, we commit an error no greater than 1 per cent, the latter amounts to more than 6 per cent in the New England States and in California. If we have a large-scale map of the United States showing the distribution of forests, 10.6 square inches in New England will represent the same surface as 10 square inches in Minnesota.. Thus we see that we cannot compare the surfaces of various parts of the United States with one another. But, besides this, the form of the single countries is distorted. We have indicated by arrows that direction in which the increase in the lengths of lines is a maximum. In the direction vertical to these arrows the decrease in the lengths of lines is a maximum. The distortion of each part of the map depends upon the relation of these two measures, and may be expressed by an angle. We observe on our map that this distortion exceeds 3° in the outlying parts of the country.

After having thus found the character of alterations in this map, we will proceed to consider whether it meets the demands that must be made upon such a map. The principal objection is, that the surfaces are very much enlarged in the outlying districts, which are at the same time among the most thickly settled. It is true that measurements may be made on sectional maps which have various central parallels; but when it is the object of the map to present at a single glance the relative extent of certain phenomena, of whatever character they may be, climatological, geological, or industrial, it is of prime importance that the surfaces in various parts of the map should be equivalent to each other. Maps which have this property are called 'authalic' or 'equivalent' maps, and we should say that it is the fundamental point that each map used for census purposes should be authalic.



SKETCH-MAP OF THE UNITED STATES SHOWING THE DIFFERENCE BETWEEN THE DISTORTIONS IN THE POLYCONIC AND CONIC PROJECTIONS.

But we might ask, if we agree that this should be the case, will not the alterations of angles become enormous, and thus our ideas of distances become altogether wrong? In order to satisfy this question, we must consider what means we have to preserve the same relation of surfaces all over the map, and at the same time to make the alteration of angles — and therefore that of distances also — as small as possible. We may first ask that this alteration be smaller than on the ordinary polyconic projection, and then we will have a map exceeding in value the former. But we present here a map that has not only slighter alterations of angles than the polyconic projection, but the surfaces of which are also preserved all over the map. While in the polyconic projection the alteration of angles very nearly reaches 4°, it does not exceed in our map 1° 16′. While the surfaces on the former projection are enlarged more than 6 per cent in the outlying regions, they are not at all altered

here. Besides this, the construction of the map is more simple than that of the polyconic map; the parallels being all concentric circles and the meridians straight lines, while in the polyconic projection each meridian must be constructed separately. But our projection has still another advantage: it is the best among all the authalic projections that are possible; that is to say, the maximum of distortion cannot be made smaller than it is in our map. A study of the map shows that the distortion reaches its maximum in the extreme southern part of the United States, in latitude 25° north, where it amounts to 1° 16′. Going north, it decreases rapidly, until in latitude 28° 58′ 49″ it vanishes. Then it increases again quickly, and in 37° 58′ 16″ again reaches its maximum of 1° 16′. Farther north it decreases, and on the parallel of 45° 58′ 55″ there is no distortion. While in this zone (from 28° 58′ 49″ to 45° 58′ 55″) the maximum of increase of length is in the direction of the meridians, while the maximum of decrease is along the parallels, it is the reverse north and south of it. From the northern line, on which no distortion exists, it increases, and reaches 1° 16′ on the 49th parallel, the northern boundary of the United States. We have indicated by various shading the regions of equal distortion on both projections. The regions situated east and west of the line of 1° 16′ distortion on the polyconic map are in every respect inferior to our map. But it will be seen that the distortion of angles in the central part of the polyconic map is slighter than in our map. The central parts of our projection, on the other hand, are inferior to the polyconic projection so far as alteration of angles is concerned, while it is superior for census purposes as being equivalent. We must not, however, consider the central parts alone, as the map is intended as one of the United States, not of parts of the States. For the central parts alone, it would be necessary to adopt another equivalent projection. In our map on the lines of maximum distortion the lines whose lengths are increased are 1.1 per cent too long, while those vertical to them are 1.1 per cent too short: therefore this is the maximum error that can be made in measuring lengths. In the polyconic projection this error is equal to the amount of deformation of surface, being 6 per cent in the Eastern and Western States.

The sketch-map on p. 62 shows the difference between the distortions of angles in these two maps. In the shaded portions the polyconic projection has a slighter deformation of angles than our projection; in the dotted portions the reverse is the case. This comparison shows that in 48 per cent of the area of the United States the polyconic projection is superior to ours regarding deformation, the maximum difference in its favor being 1° 16′, while in 52 per cent of the area ours is superior, the maximum difference in its favor being nearly 4°. A comparison between the amount of deformation in both maps gives the following results: —

Deformation.	Per Cent of the Area of the United States.	
	Conic Projection.	Polyconic Projection.
0°–1°	51	58
1°–1° 16′	49	12
1° 16′–2°	—	15
2°–3°	—	13
3°–4°	—	2

From these remarks it appears that the conic projection excels the polyconic in every respect.

It appears from our map, very clearly, that the polyconic projection has the valuable property of having very slight distortions on a wide belt situated on both sides of the central meridian. This property makes it valuable for maps showing narrow strips of land only, such as coasts of the ocean and of lakes: therefore it is serviceable for the purposes of the Coast Survey, particularly as the alteration of surface is of little or no importance to the mariner. The United States, however, have a wide extent in longitude, and a far smaller one in latitude, which makes the projection not well adapted for a map of the whole country. If the object were to construct a map of the whole territory of the United States on this projection, we ought to make use of this fact. Our country is far more extended in longitude than in latitude. But by assuming a system of parallels and meridians the pole of which is situated near latitude 12° north, longitude 175° west from Greenwich, and using this for a polyconic projection, the greatest distance from the new central meridian will be 13° instead of 30°, and the greatest distortion less than 1° instead of nearly 4°, while the increase of surface will be less than two per cent in the outlying portions. This projection may be considered quite a good one, as the central part of the country adjoining about the 40th parallel of latitude would have hardly any distortion. From this line it would increase very slowly northward and southward.

We said, however, above, that, for the purposes of a census, equivalence of surfaces must be the fundamental point of view for the construction of a map, and, as even the oblique projection just mentioned is not equivalent, it cannot be accepted. For the same reason it is necessary to take into account the spheroidal shape of the earth, which makes the computation of oblique projections difficult: therefore they will be only chosen if they offer great improvements upon others.

Assuming the central point of a circle circumscribed about the United States as a zenith, and computing a conical projection that is equivalent, and in which the alteration of angles is as slight as possible, we shall find that the maximum alteration of angle is not more than 58′, the map including the whole territory of the United States. We should recommend this map, if it were not for the fact that there would be an open sector of 10° aperture running from the centre near Omaha to the northern boundary. This is produced by the development of the cone upon which the map has been projected. The existence of this open sector is so serious an objection, that the decrease of 18′ in the deformation cannot be considered an equivalent.

By assuming an oblique conic projection the alteration of angle might be reduced to 1° 9′, but the difficulty of computing this projection for the spheroid induces us to discard it. A thorough investigation into the properties of all known projections leads us to the conclusion that the projection we propose here is the best that is possible for census purposes, and the only one that ought to be used for it. The easiness of computation of the elements adds to the properties that qualify it for an extensive use. Dr. F. BOAS.

JAMES STEVENSON.

IN the death of James Stevenson on Wednesday, July 25, the public lost the services of one of the most active and indefatigable ethnologists of the time. Certainly, so far as knowledge of the aboriginal American race habits and customs is concerned, he contributed more than any predecessor, and by his keen appreciation of the subject and tireless investigation he saved from irreparable loss much of the evidence upon which must stand all we know of many of the ancient peoples of this continent and their polity.

From an article in a recent issue of the *National Tribune* of Washington we get the following facts relating to the life and labors of Mr. Stevenson. He was born at Maysville, Ky., in 1840, and his life was devoted to the one passion of geographical and ethnological research, except when interrupted by the war.

He went West first when quite a boy, several years prior to the Rebellion, with Professor Hayden, to the Missouri River country, making unofficial observations of Indian customs, and learning their dialects. Upon the breaking-out of the war, Professor Hayden entered the service as a surgeon, and young Stevenson enlisted as a private, and became a second-lieutenant of the Thirteenth New York Volunteers. He was at the second Bull Run, and was an important witness in the famous Fitz-John Porter case.

In 1866 he resumed his explorations, going to the Bad Lands of Dakota with Professor Hayden, as his assistant in the Geological Survey. Being a warm personal friend of the late Gen. John A. Logan, young Stevenson aroused in him a deep interest in the subject of developing a better knowledge of our Western lands. Logan, at Stevenson's suggestion, conceived the idea of establishing such a survey as a distinct and responsible branch of the general government, and from his place on the floor of the House, in the winter of 1866–67, he offered an amendment to the Sundry Civil Bill appropriating the sum of five thousand dollars for such an in-

vestigation, to be made by D. F. V. Hayden. This was adopted after a warm debate, and from this small beginning the present extensive and efficient organization known as the United States Geological Survey took its origin, and its growth upwards was due almost wholly during 1868 to 1872 to Stevenson's careful management. In 1867 and 1868 he again went with the annual expeditions, the work during these two summers being chiefly in Nebraska. In 1869 he took a trip along the eastern slope of the Rocky Mountains in Colorado and New Mexico. In 1870 the party went out on the Platte and into the Green River basin.

In 1871 Professor Hayden's party made the first geological surveying trip into the Yellowstone Park; and Stevenson, as usual, went along, acting as executive officer and general manager as well as collector in his own field. They took a pack train at Bozeman and an escort of cavalry from Fort Ellis. In 1872 the Hayden survey again went into the park, in two parties this time. They rendezvoused at Ogden and divided; the main party, under Professor Hayden, going in from the north by Bozeman, as before.

Stevenson went to Fort Hall and organized the Snake River expedition, which entered the park from the south by way of the Teton Mountains. On this expedition he ascended the great Teton, and nearly lost his life through slipping and falling several hundred feet on the snow, but miraculously escaped, and persisted in an effort to reach the summit, which he accomplished. It is not known that any other white man ever set foot upon the peak. He verified an Indian tradition by finding on the mountain-top an ancient stone altar.

He joined Professor Hayden's party at Yellowstone Lake, after which they again separated, each going out in the direction by which he had entered.

The season of 1873 again found Stevenson in the field, collecting and acting as executive officer for Hayden's surveying party in Colorado; and for the three following years his work was a repetition of this experience, and in the same field. In 1877 they went to Idaho, Wyoming, and Utah, and in 1878 to Yellowstone Park once more. On this trip Mr. Stevenson made a most complete collection of those specimens of the phenomena of the Geysers, which may be seen at the Smithsonian and National Museum in Washington.

In this connection it is worthy of mention that the first hydrographic survey of the Yellowstone Lake, which was made in 1871 and published by Henry W. Elliott, assisted by Campbell Carrington, United States Geological Survey, names the largest island in that remarkable body of water 'Stevenson Island,' and the loftiest peak that overlooks it 'Mount Stevenson.' This was done by Elliott in spite of Stevenson's strong disinclination to have it so recorded. He was always modest and retiring in so far as his own individuality was concerned. Thus his name is perpetuated by the largest island in that beautiful lake and one of the highest peaks on the east side of that famous park.

In 1879 the Hayden Survey was disbanded, and the Bureau of Ethnology was organized. Major Powell, the director, at once appointed Stevenson as a specialist in ethnological work, and he began an investigation, which has made him noteworthy, among the Pueblos of the Rio Grande and at Zuñi. During this year and the next, and again in 1881, he made an exhaustive collection of pottery, costumes, and ceremonial objects. Among the rest, he secured from the Zuñis a complete collection of their animal fetiches held sacred by them, and never before allowed to go out of their possession. During 1881 he also visited the Moqui Pueblo, making vast collections of objects illustrating both the ancient and modern life of the race.

The annual report of the bureau for 1881 contains an exhaustive descriptive catalogue of his collections among these Pueblos.

In 1882 he was off again, this time to explore the remains of the cliff and cave dwellers in New Mexico and Arizona at Cañon de Chelly and Cochiti, bringing back, among other things, two perfect ancient skeletons found in the largest of the cave-dwellings of the prehistoric inhabitants. From 1883 to 1885 he continued in this work, and in 1886 he paid a visit to the Mission Indians of California. By his familiarity with the inner life of these races he was enabled to discover, that, although these Indians had been ostensibly Catholics for two centuries, still at heart they were yet Pagans, and worshipped and sacrificed to the gods of their forefathers in secret.

During the trip of 1885 he contracted the worst type of that peculiar 'mountain fever' which is so well known and dreaded in the high mesas of Arizona and New Mexico. He fought it off, however, after a severe siege of illness. It was the first real sickness that he ever had in his life, for he possessed a fine physique, and was remarkably temperate and regular in his diet and living.

Last year he returned to the New Mexico region, exploring and collecting, and renewed that wretched fever which finally destroyed the tissues of his heart, so that when he returned last December he was literally prostrated. He made, however, an heroic struggle for his life, and, growing worse as time passed on, he was advised to go to Gloucester, Mass., to spend the summer, and was on his way back from there, accompanied by his wife, when overtaken by death in New York.

His remains were taken to Washington, and after appropriate ceremonies were interred at Rock Creek Cemetery, just outside of the Soldiers' Home.

It is to be regretted that he did not write more; but the fact is, he had little time for that purpose. But as an original investigator, whose results some other hand must record, he was and is justly famous.

He left some manuscripts, however, which will have a lasting interest, one of which is upon 'The Mythologic Painting of the Navajos,' which, with the rest, will no doubt appear in due time in the publications of the bureau.

Mr. Stevenson was a man of singular firmness and rare amiability. He had an intuitive appreciation of men and what they really amounted to. This faculty made him one of the most efficient and prompt managers of the varied men of the survey, as they were despatched into the field with their outfits every spring, and recalled from it every fall.

SCIENTIFIC NEWS IN WASHINGTON.

A New Way of using Oil to calm the Troubled Sea. — How a Mound was made: Interesting Discoveries in Ohio by Mr. Gerard Fowke of the National Bureau of Ethnology. — How the Monthly Pilo Chart is made, and What it shows.

Oil-Exploding Rockets.

The pamphlet describing and explaining the exhibit sent to Cincinnati by the Hydrographic Office of the Navy Department, which is now ready for the printer, contains a description of an oil-exploding rocket invented by Mr. W. Missel of the German steamer 'Werra,' and forwarded by Lieutenant Cottman, U.S.N., in charge of the branch hydrographic office, New York. The following extracts are made: —

"It is stated that experiments have been made with this rocket at sea and on shore which have proved very successful, particularly those by the German life-saving stations. Trials were made during a fresh wind and moderate sea off the mouth of the Elbe, and the rockets were exploded outside the breakers, in the breakers, and inside of the same. Outside the breakers, oiled areas of about three hundred feet long and nearly one hundred feet wide formed and calmed the sea very much, and remained a long time on the surface of the water. Those which exploded among the breakers exercised a remarkable quieting effect, and gave evidence of their value in facilitating the handling of lifeboats in case of shipwreck, as the resulting oil areas will enable the boat to get through the breakers without shipping water.

"A trial was made at sea on board the 'Werra' by firing a rocket from the bridge directly against the wind. It flew directly ahead against a wind whose force was 9, and the oil cylinder exploded in the water. The oil at once smoothed the sea, the heavy waves facilitating its rapid spread, and no seas were seen to break within the oiled area.

"Above the rocket composition the shell is prolonged $1\frac{1}{2}$ inches to receive the oil cylinder, which contains within it an exploding chamber filled with powder. Some loose powder is poured on top of the fuze composition, and the cylinder then shipped on the rocket. The stick is weighted with lead to balance exactly, so as to prevent trembling. All being ready, the rocket is set off from a tube, and

follows the direction given it. The burning composition finally reaches the loose powder, and the flame is communicated through a small hole in the bottom of the cylinder to the bursting charge of powder within the exploding chamber, the cylinder is thrown forward and exploded, and the oil spread upon the surface of the water."

How a Mound was built.

"While exploring mounds in Ohio this season, under the direction of the National Bureau of Ethnology," says Mr. Gerard Fowke in a paper prepared for *Science*, "I used great care in the examination of one mound in Pike County, in order to ascertain, if possible, the exact method of its construction.

"The mound was built upon the site of a house, which had probably been occupied by those whose skeletons were found. The roof had been supported by side-posts, and at intervals by additional inner posts. The outer posts were arranged in pairs a few inches apart, then an interval of about three feet, then two more, and so on. They were all about eight inches in diameter, and extended from two and a half to three feet into the ground, except one a few feet from the centre, which went down fully five feet. All the holes were filled with the loose dark dirt which results from decay of wood; a few contained fragments of charcoal, burned bones or stone, but no ashes; nor was the surrounding earth at all burned.

"Around the outside a trench from three to four feet wide, and from eighteen to twenty inches deep, had been dug, to carry away the water which fell from the roof. Near the middle of this house, which measured about forty feet from side to side, a large fire had been kept burning for several hours, the ashes being removed from time to time. The ash-bed was elliptical in form, measuring about thirteen feet from east to west, and five from north to south. Under the centre of it was a hole, ten inches across and a foot deep, filled with clean white ashes in which was a little charcoal, packed very hard. At the western end, on the south side (or farthest from the centre of the house), was a mass of burned animal bones, ashes and charcoal. This was continuous with the ash-bed, though apparently not a part of it. The bones were in small pieces, and were, no doubt, the remains of a funeral feast or offering.

"After the fire died down, rude tools were used to dig a grave at the middle of the house. It measured ten feet in length, from east to west, by a little more than six in breadth. The sides were straight, slanting inward, with rounded corners. The bottom was nearly level, fourteen inches deep, but slightly lower at the centre. Over the bottom, ashes had been thinly sprinkled, and on these a single thickness of bark had been laid. The sides had been lined with wood or bark from two to four inches thick. When this was done, two bodies were placed side by side in the grave, both extended at full length on the back, with heads directly west. One, judging from the bones and condition of the teeth, was a woman of considerable age. She was placed in the middle of the grave. Her right arm lay along the side, the left hand being under the pelvic bones of the other skeleton. This was apparently of a man not much, if any, past maturity. The right arm lay across the stomach, the left across the hips. This skeleton was five feet ten inches in length; the other, five feet four inches.

"The space between the first skeleton and the south side of the grave was covered with the ashes that had been removed from the fire. Beginning at the feet in a thin layer, — a mere streak, — they gradually increased in thickness toward the head, where they were fully six inches thick. The head was embedded in them. They extended to the end of the grave, reaching across its entire width, and coming almost, but not quite, in contact with the other head. A considerable amount of the burned bones lay in the south-western corner of the grave, and the ashes along this part curved up over the side until they merged into what remained of the ash-bed. This had extended to the west slightly beyond the end of the grave.

"As the earth removed from the grave had been thrown out on every side, the bodies were in a hole that was nearly two feet deep. The next step was to cover them. There was no sign of bark, cloth, or any other protecting material above them. They were covered with a black sandy earth, which must have been brought from the creek not far distant. This was piled over them while wet, or at least damp enough to pack firmly, as it required the pick to loosen it, and, besides, was steeper on the sides than dry dirt would have been. It reached just beyond the grave on every side, and was about five and a half feet high, or as high as it could be conveniently piled.

"So far, all was plain enough; but now another question presented itself that puzzled me not a little; and that was, what became of the house? That there had been one, the arrangement of the numerous post-holes plainly showed; but the large earth-mound above the tumulus or grave was perfectly solid above the original surface, giving not the slightest evidence that the posts or any part of the house had ever reached up into it. I incline to the opinion that the great fire near the middle of the house had been made from the timbers composing it; that the upper timbers had been torn down, and the posts cut off at the surface, the whole being a kind of votive offering to the dead. At any rate, it is plain that a house stood there until the time the mound was built; and it was not there afterwards.

"For the purpose of covering the grave, sand was brought from a ridge a short distance away. There was no stratification, either horizontal or curving. Earth had been piled up first around the black mass forming the grave-mound, and then different parties had deposited their loads at convenient places, until the mound assumed its final conical arrangement. The lenticular masses through almost the whole mound showed that the earth had been carried in skins or small baskets. The completed mound was thirteen feet high, and about one hundred feet in diameter.

"Two and a half feet above the original surface was an extended skeleton, head west. It lay just east of the black earth over the grave. Sixteen feet south of the grave, on the original surface, and within the outer row of post-holes, were two skeletons extended, heads nearly west. It would seem that the flesh was removed before burial, as the bones were covered with a dull-red substance, which showed a waxy texture when worked with a knife-blade.

"No relics of any description were found with any of the skeletons; but a fine copper bracelet was picked up in a position that showed it was dropped accidentally."

The Pilot Chart of the North Atlantic Ocean.

The Pilot Chart is published by the Hydrographic Office on the first day of every month, and, although reference is frequently made to it in the daily and weekly press, no comprehensive description of it, its scope and objects, and the method of its preparation, has been written previous to a paper read a few months ago, and recently published by Mr. Everett Hayden, in charge of the Division of Marine Meteorology of the United States Hydrographic Office. In the following abstract are presented the essential parts of Mr. Hayden's paper.

The base of the Pilot Chart, the permanent portion which does not change from month to month, is simply a track chart of the North Atlantic on Mercator's projection. This is lithographed in black. Near the top is a compass-card, which the navigator uses to lay off his course; and in the lower left-hand corner, a storm-card, which illustrates the circulation of the wind around an area of low barometer, with brief practical rules for action to avoid the dangerous portions of an approaching cyclone. Light curved lines cross the chart, showing the variation of the magnetic compass, and a light dotted line near the coast is the hundred-fathom line. Small arrows indicate the general drift of ocean-currents. All of this is printed in black, and is not changed from month to month.

The portion of the chart printed in blue comprises essentially a meteorological forecast for the month following the date of issue, and in addition to this there are plotted the principal steamship and sailing routes recommended for the month. Small circles and arrows plotted uniformly over the chart indicate graphically the probable percentage of calms, and the frequency and force of the prevailing winds in each five-degree ocean square. There being no fixed meteorological stations on the high seas, it is necessary to group together observations made on board vessels in some way by which they can be localized and averaged up. This is done by dividing up the ocean into squares bounded by five degrees of latitude and longitude; and every vessel which goes through one of these squares and keeps meteorological observations adds to the

existing knowledge of the prevailing weather conditions in that square. It therefore happens that there are many squares whose meteorological conditions are very well known, on account of the very great number of vessels which traverse them; while, on the contrary, there are other squares which lie off the tracks of commerce whose meteorological conditions are only approximately known. In addition to this graphic representation of the frequency and force of prevailing winds in each ocean square, there is printed a brief forecast and a table showing the normal reading of the barometer, arranged in tabular form by ocean squares. A double dotted line near Newfoundland shows the probable limit of the region of frequent fogs for the coming month, and dotted lines across the lower parts of the chart indicate the limits of the trade-winds. Where the north-east and south-east trade-winds meet, there is the region of equatorial rains, indicated on the chart by a blue belt of irregular shape, lying principally north of the equator. These constitute the blue data or portions of the chart.

The portions of the chart printed in red comprise information collected during the month preceding the date of issue. On the ocean are plotted the latest reported positions of derelict vessels, wrecks and drifting buoys. Dotted lines indicate the drift which each wreck has followed since it was first reported. There are also plotted the positions where whales and waterspouts were reported during the previous month, and a red belt off Newfoundland indicates the region where frequent fogs were encountered. In the lower right-hand corner is printed a brief weather review of the preceding month, written at the last moment before going to press, but necessarily more or less incomplete so far as the entire Atlantic is concerned. Above is a large amount of printed matter, comprising a list of notices to mariners issued during the previous month, dangerous obstructions to navigation along the coast, charts published and cancelled, transatlantic steamship and sailing routes, the latest reported positions of logs from the big lumber raft which was abandoned off Nantucket, and various other matter likely to be of timely interest. To one who is not familiar with the subject it would seem almost impossible to publish on one chart such a variety of information of such a diverse character, and yet have a chart that can be of practical use in plotting a vessel's track. It would be very difficult to do without the distinction of colors.

In describing the methods by which the data for the Pilot Chart are collected from masters of vessels, Mr. Hayden referred to the branch hydrographic offices established in Boston, New York, Philadelphia, Baltimore, New Orleans, and San Francisco. At these offices masters of vessels can find all the latest nautical information — charts, light-lists, sailing directions — for every ocean of the globe, and standard barometers and thermometers for purposes of comparison. The naval officer in charge of such a branch office, during his three-years' tour of shore duty, is thrown into intimate relations with the owners, agents, and especially with the practical and energetic masters, of merchant vessels of every description, to mutual advantage, and to the benefit of both the commercial marine and the naval service. Mr. Hayden referred for illustration to the working of the branch office established in the Maritime Exchange, New York, which Lieut. V. L. Cottman, U.S.N., during the few years he has been in charge, has brought into a position of usefulness commensurate with the vast shipping interests of the great commercial metropolis of the United States. In a single year (1886–87), 6,739 vessels were visited, nautical information furnished to 83,345 masters of vessels and others, 10,397 Pilot Charts distributed, and 3,601 special detailed reports of marine meteorology forwarded for use in the preparation of the Pilot Chart alone, in addition to all the regular office-work, of which this is but a small fraction.

ELECTRICAL SCIENCE.

Change of Potential in a Voltaic Couple by Variation of Strength of the Liquid.

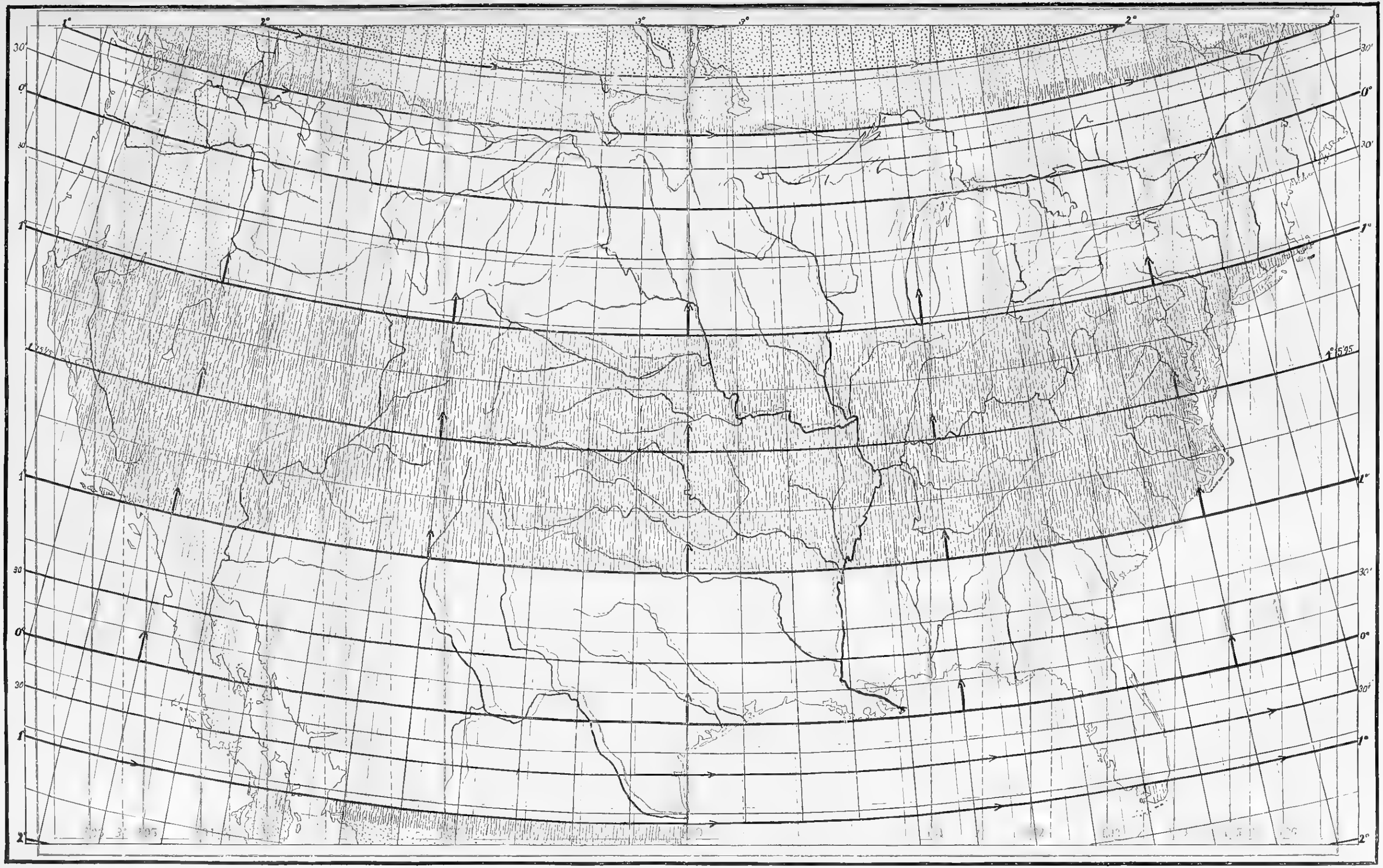
DR. G. GORE, F.R.S., read before the Royal Society, June 14, a communication on the above subject. A voltaic couple, consisting of zinc and platinum in distilled water, was opposed to a thermo-electric pile, the latter being regulated until there was no deflection of a galvanometer in the circuit. To the distilled water there was added potassic chlorate, potassic chloride, hydrochloric acid, or bromine, in gradually increasing quantities, and the change in the electro-motive force of the voltaic couple was measured in each case. The following are the minimum proportions of the above substances required to change the potential of the couple in water: potassic chlorate, between 1 in 221 and 1 in 258 parts of water; potassic chloride, between 1 in 695,067 and 1,390,134; hydrochloric acid, between 1 in 9,300,000 and 9,388,188; of bromine, between 1 in 77,500,000 and 84,545,000 parts. With each of these substances a gradual and uniform increase of the strength of the solution from the weakest to a saturated solution was attended by a more or less irregular change of electro-motive force.

By plotting the results in curves, — the quantities of dissolved substance as ordinates, the electro-motive forces as abscissæ, — each substance will yield a different curve, the form of which is characteristic of the substance.

As a very slight addition of a foreign substance greatly changes the 'minimum point,' and alters the curve of variation of potential, the two may probably be used as tests of the chemical composition of the substance, and as a means of examining its state of combination when dissolved.

THE 'MINIMUM POINT' OF CHANGE OF POTENTIAL OF A VOLTAIC COUPLE. — Dr. Gore, at the same meeting of the Royal Society, described experiments made to determine the minimum amount of any substance that would affect the electro-motive force of a voltaic cell. To do this he arranged two magnesium-platinum couples in distilled water, and opposed them to each other with a sensitive galvanometer in their circuit. He then added known quantities of the substances to be investigated to one of the cells, and noted when the balance between the two couples was upset. The results were as follows: potassic chloride, between 1 part in 3,875 and 4,650 parts of water; potassic chlorate, between 1 in 4,650 and 5,166; hydrochloric acid, between 1 in 516,666 and 664,285; chlorine, between 1 in 15,656,500,000 and 19,565,210,000. The proportion required of each of these different substances is dependent upon very simple conditions, — unchanged composition of the voltaic couple, uniform temperature, and the employment of the same galvanometer. If a more sensitive galvanometer was employed, of course the numbers would be increased, but they are relatively correct. With constant conditions, the numbers obtained may possibly be used to test the purity or the uniformity of composition of the dissolved substances. The 'minimum point' varies with (1) the chemical composition of the liquid; (2) the kind of positive metal; (3) to a less degree with the kind of negative metal; (4) the temperature at the surface of the positive metal, and that of the negative one; (5) with the galvanometer used. The degree of sensitiveness is related to the degree of free chemical energy of the liquid, also to the atomic and molecular weights of the dissolved substances. The greater the degree of the free chemical energy of the dissolved substance, and the greater its action upon the positive metal, the smaller the proportion of it required to change the potential. As the 'minimum point' of a substance dissolved in water is usually much altered by adding almost any soluble substance to the mixture, measurements of that point in a number of liquids at a given temperature, with the same voltaic pair and galvanometer, will probably throw some light upon the degree of chemical freedom of substances dissolved in water.

ELECTRICAL TREATMENT OF ZINC AND ITS ORES. — Mr. Alexander Watt has brought forward a process of purifying and reducing zinc that promises to be largely used. In the purifying process the zinc is made the anode in a bath containing an organic acid, and is dissolved and deposited upon the cathode. Acetic acid is generally used in the process, the ordinary commercial acid being mixed with water in the proportion of one to two. The impure zinc plates are suspended in the bath, and the pure zinc is deposited on thin zinc plates, or on copper or iron plates coated with plumbago. When the operation is finished, the cathode plates are washed, and melted into ingots. To reduce the ores of zinc, especially the carbonate, the minerals are first reduced to a powder, and then submitted to the action of the acid, being added a little at a time. When the zinc is completely dissolved, the liquid is allowed to stand, and is then drawn off, and mixed with water in equal pro-



Polyconic Projection in Red.

Conic Projection in Black.

Sketch Map of the United States,

Showing the Deformations of the Polyconic and Conic Projections.

— BY —

N. F. BOAS.

portions. In electrolyzing this liquid the anode plates are carbon, platinum, or some other substance not acted on by the acid: the cathode plates are zinc, carbon, etc. To keep the saturation constant, and to prevent polarization from an excess of free acid, Mr. Watt has devised a system of circulation by which the used-up liquid is restored to its original density in special reservoirs, and is used over and over again. In the treatment of blende or native sulphate of zinc, the ores are first roasted, after which they are pulverized and put in acid, as has been described. The process is said to be more economical than those now in use, but it has not been tested by experiment on a large scale.

ELECTRIC TESTING BUREAU AT JOHNS HOPKINS UNIVERSITY. — In a circular that has just been issued by the Johns Hopkins University is the announcement that an electric testing bureau is to be opened from Sept. 1. The circular, besides the announcement, gives the general methods of measurement that are to be employed. Such a bureau has been needed for some years. With the rapid increase in the number and importance of the applications of electricity in this country, the necessity of more accurate methods of measurement has become more and more apparent. In order that such measurements shall be uniform and comparable, they must be in terms of the same standards, and these standards should be referred to the system of absolute units, whose adoption has been of such benefit to physical science. The instruments in use for commercial measurements have constants that are liable to change in time; and electrical resistances, especially those used in accurate researches, should be carefully compared with standards. But besides the comparison of instruments and resistances, tests of batteries, dynamos, motors, etc., are to be made. This is an especially valuable feature, for almost every day brings the invention of some new storage or primary battery, dynamo, or motor, and it is not often that the inventor is in position to accurately test the value of his invention. For those who wish to develop any new discovery, it would be well to have some place of reference, where its value and possibilities can be impartially determined. The establishment of similar bureaus in France, Germany, Austria, and England has called attention to the necessity of something of the kind here. The applications of electricity in this country are much more important and extended than in any other, and it is to be hoped that this new departure will aid in their development. The Johns Hopkins University seems especially fitted to undertake the work; for, besides the excellent equipment of the laboratories, the institution has been more or less identified with accurate measurements since the classical determination of the mechanical equivalent of heat, made in 1878 by Professor Rowland. More lately important experiments have been made on the determination of the ohm, and the specific resistance of mercury. The list of prices given in the circular is reasonable, and the bureau should be well patronized.

HEALTH MATTERS.

Malaria.

THE subject of malaria and its causation was thoroughly discussed at the last meeting of the American Medical Association. One of the contributions was from the pen of Dr. Henry B. Baker. His conclusions were as follows: 1. Intermittent fever is proportional, directly or inversely, to the average daily range of atmospheric temperature. 2. The controlling cause of intermittent fever is exposure to insidious changes in the atmospheric temperature. 3. In the mechanism of the causation of intermittent fever the chief factor is the delay in the re-action to exposure to cool air: this delay, extending to a time when greater heat loss should occur, results in the abnormal accumulation of heat in the interior of the body and in disturbed nervous action, — the chill; and the final re-action is excessive, because of the accumulation of heat, and sometimes because it occurs at the warmest part of the day. 4. The fever is the excessive re-action from the insidious influence of the exposure to cool air; and it is periodical because of the periodicity of nervous action, and because the exposure and the consequent chill are periodical, owing to the absence of the warmth from the sun at night. 5. Residence in valleys or on lowlands through which or upon which cold air flows at night, and thus causes insidious changes in the atmospheric temperature, favors intermittent fever. 6. In our climate those measures, such as drainage, which enable the soil to retain warmth during the night, and thus reduce the daily range of temperature immediately over such soil, tend to decrease intermittent fever among residents thereon. 7. In the cure and prophylaxis of intermittent fever, those remedies are useful which lessen torpidity (especially of the liver) and tend to increase the power of the body to re-act promptly to insidious changes in atmospheric temperature.

A paper entitled 'Malaria and the Causation of Fever in the State of New York' was presented by Dr. A. N. Bell of Brooklyn. As a result of his observation and study, he concludes that malaria is coincident with accumulations of organic matter in process of putrefaction in alluvial bottoms, on the margins of sluggish streams, low humid borders of stagnant ponds and lakes, the marshy borders of the seashore, and circumscribed local conditions, chiefly artificial, comprehending more or less the same relations to vegetable *débris* and other organic matter in process of decay as the outlying conditions mentioned in this connection. While it is not possible in the present state of our knowledge to determine the special relations existing between malarial diseases and the geological, thermal, hygrometrical, and barometrical conditions under which they occur, those thermal and hygrometrical conditions most promotive of putrefaction coincident with the absence of sunlight are in the highest degree promotive of malarial poison.

Prof. Tommasi Crudeli sent a letter to the association, expressing the opinion that it was impossible for a person to have ague without the presence in his body of the *bacillus malariæ*. Dr. Bernardo Schiavuzzi of Pola, in a written communication, expressed himself a believer in this bacillus, and supported his belief by a statement of experiments on rabbits. Professor Laveran sent a paper on the *hematozoon malariæ*.

CANCER. — The fatal result which almost inevitably attends cancer has caused investigators to search with unremitting zeal for a specific. This search is now prosecuted with more hopefulness than ever, by reason of the belief in many minds that cancer is a specific disease depending on a germ for its causation. One of the remedies from which much was expected was Chian turpentine. Although this has had its advocates in the past, it has never sustained a very high place in the profession generally. Recently it has again come into favor, principally through the reported cures occurring in the practice of Professor John Clay, obstetric surgeon to the Queen's Hospital, Birmingham, England. In these reports are included cases of cancer of the uterus, rectum, and skin. At the same time a trial of the remedy at the London Cancer Hospital has been made, with conflicting results. Dr. Daniel Lewis, surgeon to the New York Skin and Cancer Hospital, reports hopefully of the remedy, but in a communication to the New York *Medical Journal* says that he has been using it in too limited a number of cases to decide as to its curative properties. Chian turpentine is the product of a tree, the *Pistacia terebinthus*, which grows on the island of Scio in the Mediterranean. The turpentine, as it comes to this country, is a soft solid, becoming brittle when exposed to the air. It has an agreeable odor, somewhat like that of turpentine, and very little taste. The remedy is given in the form of an emulsion with mucilage of acacia, a solution of the turpentine having first been made with sulphuric ether.

TYPHOID FEVER. — The Paris correspondent of the New York *Medical Journal* reports that Professor Proust, who holds the chair of hygiene at the faculty of medicine there, has been giving a series of lectures on epidemics of typhoid fever and other diseases provoked by the ingestion of meat from diseased animals. One of the most important questions raised is that of whether it has been established that typhoid fever is a specific malady, caused by a certain organism called Eberth's bacillus. In Paris this doctrine has for the most part been accepted since the late studies made by Professor Brouardel and Dr. Chantemesse, who showed that this bacillus could be traced to the water-supply. It will be remembered, however, that Murchison held that the typhoid contagium could be developed in any putrid matter, and by this theory it is

easy to explain how meat could be infected by the typhoid element; but if we accept the bacillus as the sole specific cause, and reject the pythogenic theory, which attributes the generation of the contagium to the fermentation of fæcal matters independently of any specific germ, we must prove that these epidemics were caused by meat containing the bacillus first seen by Klebs and then by Eberth, and lately found in the living body by Chantemesse and Widal in Paris. But this is far from proved. Chauveau and Nocard, who are among the most celebrated of French physiologists occupied with the study of animals, state that they do not believe in the existence of typhoid fever in animals. Walder, however, while making an autopsy of a heifer during the epidemic at Kloten, saw that the animal had tumefaction and softening of the mesenteric ganglia and of Peyer's patches, the latter presenting signs of ulceration. A second animal examined presented the same lesions, and both belonged to a farmer who had the fever himself. It was thought, however, that these animals had had access to matters coming from the family who were ill with the fever, and also to matters coming from autopsies made on other animals. In any case, Walder sought to prove that animals could take typhoid fever. The modern progress of bacteriological study will allow us to prove the existence of Eberth's bacillus in man, as well as in animals, in case of an epidemic; but quite recent observations seem to show that different bacilli may produce typhoid states in both man and animals, so that the question is not as yet settled. There have been five well-known epidemics where typhoid symptoms resulted from the ingestion of meat in Switzerland since 1839, when it commenced at Andelfingen, up to Kloten in 1878, and Würenlos and Spreitenbach in 1880-81. In the first, some 450 persons were attacked, and over 700 at Kloten. Both of these epidemics followed great dinners given by musical societies, and the meat eaten was veal. The symptoms were those of typhoid fever, with the usual thermometric rise and fall so well described by Wunderlich. The autopsies made showed also the usual signs found after typhoid fever. The matter is important enough to make us insist on the fullest examination of all meat exposed for sale.

A SIMPLE FILTER. — Dr. F. A. Castle of New York thus describes, in a letter to the New York *Medical Journal*, a simple, and, as he claims, efficient filter: "For a long time I have used in my butler's pantry a simple contrivance for filtering water used on the table, which has been so serviceable, and at the same time so inexpensive, that I venture to recommend it. I took an ordinary glass pharmaceutical percolator, and packed the outlet with absorbent cotton so tightly that the water could only flow in drops. By means of a piece of copper wire for a bale, it was suspended from a hook on the lower side of one of the pantry shelves, over the shelf of the sink. As often as necessary, water is poured into the percolator, and the water-pitcher is placed under the outlet. Whenever the cotton shows much discoloration, — a thing which is easily observed, owing to the percolator being of glass, — the maid replaces it with fresh absorbent cotton. It is in all respects the most practical and cheapest filter I know of, and has no machinery to get out of order, no patent right to carry, and the advantage over most filters that the filtering medium is always under observation, so that there is little risk of contamination of the water by accumulations of filth."

PRECAUTIONS IN BATHING. — We have already called attention in *Science* to the danger of injury to the ear in bathing as described by Dr. Samuel Sexton. The London *Lancet*, in the following language, directs attention to still another danger. The bathing season, though not yet advanced, has already been marked by the levy of that fatal tribute which year by year is exacted of the ignorant and the indiscreet. The recent death by drowning of a young man in the public baths at Poplar suggests one cause of accident which is too apt to be overlooked. The deceased had entered the water soon after partaking of a hearty meal, and the fatal result was attributed to cerebral congestion due to sudden immersion at such a time. What may have been the particular appearances observed after death in this case we have no means of judging, but it may be well to consider shortly some reasons why the practice of bathing soon after meals is justly condemned. Effusion of blood in or upon the brain, when it occurs in such cases as that already referred to, is probably not a primary cause of mischief, but rather a consequence founded on other circulatory and nervous disturbances. It is an evidence of eclampsia, and the physiological basis upon which this is founded consists in that inward diversion of blood toward the alimentary tract which characterizes normal digestion; the other tissues, notably the brain, being at the same time proportionally anæmic, and the action of heart and lungs impeded by a distended stomach. A natural result of cold immersion at this stage is to encourage or induce a tendency to syncope, to concentrate surface blood still more about the central organs, including the heart, which, especially if at all unequal to its duties, labors ineffectually to re-adjust the blood-pressure, and finally succumbs with lungs and venous system engorged by passive congestion. It is as if an enemy occupied the outworks of a fortress left for a time unguarded, and forthwith paralyzed the resistance of the citadel. It is best, therefore, to wait for at least an hour and a half or two hours after a good meal before bathing. Another danger to be avoided is that of cramp. This is particularly apt to occur after severe exercise or long immersion. The effect of cold being to prolong the contraction, while exhaustion lowers both the power and the elastic recoil of muscle, it is evident that we have in a combination of these forces all that is required for the production of this dangerous condition. The obvious warning implied in these remarks requires no further admonition to impress the fact that the bather in cold water must be economical of time, and free from any appreciable signs of muscular exhaustion.

THE TUNING-FORK IN THE DIAGNOSIS OF EAR AFFECTIONS. — Dr. O. D. Pomeroy of New York, in a paper read before the Medical Society of the State of New York at its last annual meeting, discussed the use of the tuning-fork in the differential diagnosis of ear affections. The fork which he employs is of large size, being eight inches in length. It has thick prongs, and gives a strong vibration. Its pitch is A of the middle tenor register, and it vibrates something over four hundred to the second. He finds that the absolute or total bone-conduction, with the fork placed on the mastoid of a closed normal ear, is as great as can be found in any case of middle-ear disease, and greater than when disease of the labyrinth is present. There are several difficulties in the way of obtaining a reliable test for bone-conduction. One is the inability of many patients to distinguish between vibrations which are felt and those which are heard. Any part of the body susceptible of vibrating in unison with a tuning-fork of a given pitch will feel the vibration without having heard it. Few people who have heard a pipe-organ will fail to remember, that, when some of the lower notes are sounded, a rumbling or a jarring sensation in some part of the body is experienced, which, of course, is not a matter of acoustic irritation, but one of general sensation. In one case of a patient who had suffered from meningitis, which left her totally deaf, when the tuning-fork was applied to the elbow she insisted that she heard it distinctly. Dr. Pomeroy gives the following summary as the result of his study of the subject: "I conclude that the greatest amount of bone-conduction proceeds from a normal ear closed, and that the principal diagnostic sign of labyrinthine disease appears in weakened bone-conduction; that the apparent increase of bone-conduction in middle-ear disease will disappear when the test is made with the ear closed, when it will be found not to exceed that of the normal ear (in those cases called 'mixed' the bone-conduction will be found weakened when the test is made with the ear closed, although with both ears open the affected one may have better bone-conduction than its fellow); that, so far, it seems that the good or bad condition of the middle-ear mechanism has little influence on bone-conduction; that the occasional phenomenon of intermittent bone-conduction cannot be satisfactorily explained; that cases of pure labyrinthine disease cannot always be distinguished from those of middle-ear affections with secondary labyrinthine changes by the tuning-fork, and that the history of the cases must materially aid us in the distinction; that the phenomenon of secondary labyrinthine changes in middle-ear diseases is easily explainable; that there are numerous exceptions to the rules for finding the best points on the head for eliciting bone-conduction; that the bone-conduction is rarely or never of less than its proper ratio to aerial conduction."

BOOK-REVIEWS.

Ptomaines and Leucomaines, or the Putrefactive and Physiological Alkaloids. By VICTOR C. VAUGHAN and FREDERICK G. NOVY. Philadelphia, Lea Bros. 12°.

PROFESSOR VAUGHAN and Mr. Novy have done the scientific world great service in collating the facts connected with ptomaines and leucomaines. The literature of the subject is abundant, but has been so scattered and so fragmentary that it was not available for reference. In the book before us a very complete historical sketch of the subject has been given, and for those who wish to consult the original articles which have appeared, a very excellent bibliography is provided. This work is more than a mere compilation. Professor Vaughan has done a large amount of original and valuable work in this branch of scientific research, and his views and methods are here given to the public. In the chapter devoted to the consideration of the foods containing poisonous ptomaines, the authors mention mussels, sausage, ham, canned meats and fruits, cheese, milk, ice-cream, and bread as having been proved at various times to contain poisonous alkaloids. These observations are made the more interesting by being accompanied with the details of the cases, and are of special value to the physician by reason of the detailed symptoms and progress of the illness. The relation of ptomaines to disease is fully discussed. The authors express the view that an infectious disease arises when a specific, pathogenic micro-organism, having gained admittance to the body, and having found the conditions favorable, grows and multiplies, and in so doing elaborates a chemical poison which induces its characteristic effects. In the systemic infectious diseases, such as anthrax, typhoid-fever, and cholera, this poison is undoubtedly taken into the general circulation, and affects the central nervous system. Among the methods of extracting ptomaines, those of Stas-Otto, Dragendorff, Brieger, Gautier, and Etard are described, and preference given to the Stas-Otto, recognizing, however, that this method is not perfect.

Several chapters are devoted to the leucomaines, or those basic substances which are found in the living tissues, either as the products of fermentation changes or of retrograde metamorphosis, as distinguished from ptomaines, or those which are formed during the putrefaction of organic matter. The closing chapter, on the pathological importance of the leucomaines, is full of suggestion to the practising physician. The authors truly say that while the medical profession has been giving much time, attention, and energy in recent years to the study of infectious diseases, it has too much neglected a large and important class of ailments which arise within the body itself, and which may be called autogenous. They believe that the individual may be poisoned by his own excretions, and that bilious attacks, attacks due to torpid livers, etc., are due to the absorption into the general circulation of peptones which are formed faster than the liver can convert them into globulin, and that they act as poisons, or that poisonous alkaloids are formed and absorbed. The opinion is expressed that ordinary colds are due to the retention of certain effete matters which are normally excreted by the skin, and that fevers are often produced in the same manner. This chapter alone is worth the price of the book to the practising physician.

Longmans' School Geography. By GEORGE G. CHISHOLM. London, Longmans, Green, & Co. 12°. $1.05.

Elementary Physiography. By JOHN THORNTON. London and New York, Longmans, Green, & Co. 12°. 80 cents.

THE endeavors of the Royal Geographical Society of London to improve the methods of teaching geography have resulted in the publication of a great number of text-books, among which Chisholm's work is one of the earliest. The author has adopted the methods of teaching in use in Germany, and followed to a certain extent the models of Wagner's and Supan's geographies. We recommend his book to teachers as suggestive of a good method of teaching geography. It is of particular value on account of the numerous references to an introduction treating mathematical and physical geography. The book contains very few names and figures, but describes the character and productions of the various countries that are discussed briefly. The facts are as a rule accurate, although a few errors occur. The author emphasizes in his preface that to teach geography adequately the aid of maps is necessary, and therefore many portions of the book must be considered hints to the teacher, not full descriptions of the countries treated. Undoubtedly the present book will be a valuable help to finding a satisfactory method of teaching geography.

Another attempt to improve the methods of teaching geography is Thornton's 'Elementary Physiography.' It does not cover the field of descriptions of countries, but the author treats in a very satisfactory way the problems of physics as applied to the phenomena of our planet. The author has followed the lines of the recast Syllabus recently issued by the Science Department, South Kensington. We believe that the method advocated in this book and in the new Syllabus is capable of the most satisfactory results in the hands of a skilful teacher. If applied consistently, it will lead to the teaching of the various branches of science by observation of the phenomena of nature. It is evident that the teaching of geography on the methods advocated by Geikie and others must necessarily include the teaching of physics, chemistry, botany, zoölogy, and geology, and that it is only a change of name if we call it physiography. All attempts to improve the methods of teaching geography have followed these lines, and we do not doubt that it will finally result in a re-organization of the methods of teaching science. The great advantage of the new method is its being more concrete than the old one, educating the child to observe the phenomena among which it lives, instead of beginning with the experiment. This is, at the same time, a valuable counterbalance against the one-sided training of the faculty of reasoning to which the teaching of science easily leads; the observation of life being a powerful means of educating the love of nature and the feeling of the child. It is principally from this point of view that we welcome Thornton's book, which first discusses physical laws and then applies them to geographical phenomena. From what we have said above, it will be clear that we should prefer the reverse arrangement; but the teacher will, of course, be able to use the book as well in applying physical laws to phenomena as in finding the laws by studying the phenomena. The descriptive part of geography as treated in Chisholm's book ought to be the subject of the teaching of geography proper, which assumes the knowledge of the general laws of physiography. If we define geography in this way, it will be understood that it can best be taught in connection with history, as it treats of countries and their inhabitants. We wish that general anthropogeographical statements were excluded altogether from school-books, as they are always misleading, and promote a superficiality in the way of treating historical and political questions which ought to be avoided. The influence of a country upon the development of its inhabitants is most satisfactorily treated in teaching its history. Chisholm's and Thornton's books will help to remodel the teaching of geography and science so as to make them important branches of our systems of education.

NOTES AND NEWS.

THE quarantine act approved by the President last week provides for the immediate establishment of eight new federal quarantine stations at the following points: one at the mouth of Delaware Bay; one near Cape Charles, at the entrance of Chesapeake Bay; one on the Georgia coast; one at or near Key West; one in San Diego harbor; one in San Francisco harbor; and one at or near Port Townsend, at the entrance to Puget Sound. The aggregate sum appropriated for the establishment and maintenance during the present fiscal year is $511,500. This extension of the national quarantine service is certain to give the country much better protection than it has ever had against the introduction of infectious diseases.

— William A. Croffut, who has been appointed executive officer of the Geological Survey, in the place of the late James A. Stevenson, is a well-known journalist. He is a man of great energy and an unbounded capacity for work, and will undoubtedly fill with success the difficult position in which he is placed. He has a taste for scientific investigation, and has lately given much attention to the subject of hypnotism, both studying its philosophy and making practical experiments. Mr. Croffut's appointment is especially gratifying to the journalists of Washington, with whom he is very popular.

— The circular of the New York Mineralogical Club, with its programme of Saturday afternoon field-meetings during June and July, was widely distributed, and aroused much interest, not only among the membership of the club, but among many others engaged in kindred studies. The trips taken have been both pleasant and profitable, and have been attended by increasing numbers. A second circular has been issued, in the belief that it will not alone afford the club further opportunities of useful study and agreeable intercourse, but tend yet more to bring together the workers in allied fields. Several other scientific societies and circles have expressed a wish and purpose to join in some of the proposed trips, and the club has already enjoyed the company of a number of friends and co-workers.

— Cupples & Hurd will publish at once a cheap edition of 'The Story of an African Farm;' also an illustrated guide to the Island of Bermuda, by James H. Stark. —— Ginn & Co. will publish early next month 'Footprints of Travel, or Journeying in many Lands,' by Maturin M. Ballou. The purpose of this work is to furnish a reader for use in public schools. —— Stuart Cumberland, the 'thought-reader,' is about to publish a volume on 'Famous Men I have known.' —— Mr. George Redway, London, who has made a specialty of this class of literature, announces an 'esoteric' series, to consist, for the most part, of reprints of old books dealing with alchemy, astrology, freemasonry, magic, and Rosicrucian mysticism. Among the first to appear will be the works of the anonymous cosmopolite philospher, known as Eirenæus Philalethes; and the 'Lumen de Lumine' of Thomas Vaughan, who wrote under the name of Eugenius Philalethes. —— Henry Stevens & Son, London, have in press a volume entitled 'Americanisms, Old and New: a Dictionary of Words, Phrases, and Colloquialisms Peculiar to the United States, British America, the West Indies, etc.; their Derivation, Meaning, and Application, together with Numerous Anecdotal, Historical, Explanatory, and Folk-Lore Notes, and a Critical Introduction,' compiled and edited by John S. Farmer, author of 'Ex Oriente Lux,' ''Twixt Two Worlds,' etc. The book will be printed for private circulation among a limited number of subscribers only. —— The Reform Club has begun, at 52 William St., New York, the publication of a semi-monthly journal of handy dimensions, called *Tariff Reform*. —— The July issue of the *Westminster Review* (Leonard Scott Publishing Company) has articles of cosmopolitan interest on 'Nurses and Nursing;' 'Mental Deterioration, Some of its Avoidable Causes;' and 'Characteristics of American Cities.' —— *The Cosmopolitan Magazine*, the publication of which was suspended last May, will now be issued monthly by a new company. Mr. J. N. Hallock, of *The Christian at Work*, is a member of the new company, and the editorial department will be conducted by Mr. E. D. Walker. —— *The Journal of Pedagogy*, Athens, O., beginning with No. 11 of Vol. I., will contain from twenty to twenty-four pages of reading-matter, instead of sixteen as heretofore. —— In the *Century* for August, Professor Holden begins his series of two articles on sidereal astronomy, old and new. The one now given briefly chronicles the data which astronomy has collected up to date: it tells of the methods of naming the stars, their number, the star charts, catalogues, etc. These articles are appropriate to the star-gazing season. —— In the *Andover Review* for August the opening article is by Morrison I. Swift, Esq., who treats of the duty of society with reference to 'trusts.' He states the objections to such combinations, reviews proposed methods of treatment, and argues intelligently for their 'acceptance and thoroughgoing regulation.' Rev. Francis H. Johnson contributes a criticism of methods of harmonizing Christianity and science by sacrificing the distinctive characteristics of the former as a divine revelation. —— In the midsummer issue of *The American Magazine*, Dr. W. F. Hutchinson presents the fourth of his illustrated articles in the series 'Along the Caribbean,' in this instance dealing with Trinidad; and Frederick G. Schwatka tells about 'The American Arctic Savage.' —— Ticknor & Co. have ready 'A History of Presidential Elections,' by Edward Stanwood.

— According to *Agricultural Science*, Prof. W. P. Brooks, at present president of the Imperial College of Agriculture, Sapporo, Japan, is to be the next professor of agriculture at the Massachusetts Agricultural College. Professor Brooks went to Japan about twelve years ago to teach agriculture in the newly started college. Later he became its president. He is considered one of the ablest graduates of the Massachusetts Agricultural College, and his selection for the place in question is for many reasons a wise one. Professor Brooks was born in 1851.

— In accordance with the provisions of the constitution, the committee of the Nineteenth Century Club has selected from the list of vice-presidents Mr. Daniel G. Thompson as president, to fill Mr. Palmer's unexpired term.

—The American Statistical Association recently issued the first number of its Proceedings, on 'Statistics of Water-Power,' by G. F. Swain. This association has been organized and maintained for nearly half a century; up to this time, however, it has been almost entirely a local society of Boston. It now desires to extend its scope, so as to make its interests and influence national. It is intended in an early number of the publications to begin a record of statistical publications in various departments of knowledge, — a record which it is hoped will be a serviceable guide.

— The Middlesex Institute, Malden, Mass., has issued 'Flora of Middlesex County,' by L. L. Dame and F. S. Collins. The authors acknowledge their indebtedness to Dr. Gray, Dr. Farlow, and other leading botanists.

— It is now seven years since the International Geographical Congress at Venice adjourned, and it seemed as though these important conventions which have proved so fruitful for the promotion of geographical investigations were totally abandoned. It is therefore with great pleasure that we learn of the plan of the French Geographical Society to convene an international geographical congress during the universal exhibition that is to be held next year. Each society represented at the congress will be invited to submit a report on the progress of geographical work in the country to which it belongs, during the last century, and this plan promises to yield interesting and valuable results.

— Since the report of Dr. Elkin to the Board of Managers of the Observatory of Yale University in 1887, the series of observations on the parallaxes of the ten stars of the first magnitude in the northern hemisphere has been brought to a close. The average or mean parallax of the stars is $+0.''085 \pm 0.''015$, to which should probably be added $+0.''004$ as the probable parallax of the comparison stars which are in the mean of about the eighth magnitude, giving $+0.''089 \pm 0.''015$ for the result sought for. Dr. Elkin does not, however, in view of the wide range of distance implied by the values of his table, feel at all certain that this result may be taken as a measure of the average distance of the stars in question, and at all events it must be considered only as provisional and partial until it can be combined with the result for the first-magnitude stars of the southern hemisphere, now in course of determination by Dr. Gill. At the same time he draws attention to its near coincidence with the values derived by Gyldén ($0.''084$) and Peters ($0.''102$), without laying too much stress on this agreement.

— Arrangements have been made for re-determining the difference in longitude between Paris and Greenwich. The geodetic station at Montsouris, which has already been connected with the principal European surveys, will be used for the French observations, and Greenwich Observatory for the English.

— The length of pipe laid in Paris for the distribution of power by compressed air already exceeds 30 miles. The compressing-engines are of 3000-horse power, and about 3,000,000 cubic feet of air are compressed daily to a pressure of 80 pounds per square inch, at an expenditure of 50 tons of coal.

— In the last number of the *Zeitschrift für Hygiene*, under the title of 'Experimente über die bacterienfeindlichen Einflüsse des thierischen Körpers,' Dr. George Nuttall of San Francisco publishes some interesting results of a large number of experiments made by him in Flügge's laboratory during the past year and a half. He finds that freshly drawn blood, humor aqueus, pericardial fluid, and in the case of man also pleuritic exudate, have the power of killing off bacteria to an astonishing degree, but only for a period of three to four hours after removal from the body. The blood of various animals acted differently; for instance, that of an immune sheep killed off four times as many anthrax bacilli as that

of a sheep not rendered immune against the disease; the blood of the rabbit killed off many bacteria, more, in fact, than the blood of sheep, sheep being, as is well known, much more susceptible to the disease than rabbits. On the other hand, the blood of a mouse had no visible effect on bacilli, in the latter case the animal being extremely sensitive to the disease. That the animal cells do not play any thing like the active *rôle* frequently assigned to them ('Phagocyte' theory of Metschnikoff and followers) is pretty clearly shown, it being found that the bacteria die off quite independently of the cells or leucocyte in and out of the body. Of saprophytic bacteria some forms are found more sensitive than others. Fluids taken from various individuals of the same species vary to some extent in their germicidal qualities. To give an idea of the intensity of this action, a case or two might be cited. Five drops of defibrinated rabbit's blood, placed at 37-38° C., reduces the number of anthrax bacilli inoculated into it from about 15,000 to 5 at the end of an hour; in another case, from about 90,000 to 0 at the end of four and five hours. Rabbit humor aqueus (contains little or no cellular elements) reduces the number of anthrax bacilli inoculated into it from about 10,000 to 1, and in another case to 0, at the end of two hours; in fresh human pleuritic exudate, 230 anthrax bacilli are entirely killed off after one and two hours. Human saliva was also found to kill off large numbers of bacteria in a short time. The encouraging of bleeding, and the sucking of a wound in certain cases, may not be bad treatment, after all, when we consider the result of the above experimental research.

— Prof. F. W. Clarke describes, in a contribution to the *American Journal of Science*, the results of a series of investigations into the manner of formation of nickel silicates. About the year 1881 extensive deposits of this ore were found in Douglas County, Oregon. They lie near the surface in beds from four to thirty feet thick, and no second beds have been found underlying the first. Most of the samples obtained are intermixed with oxides of iron and with quartz, and are seamed with chalcedony. All of them are undoubtedly products of alteration, which is true of similar samples procured from the deposits in New Caledonia and in North Carolina. The country rock in these three localities is almost identical, consisting of a greenish rock, composed of olivine partially altered into serpentine, and having considerable quantities of enstatite mingled with it. The only noticeable difference in occurrence was that chromic iron, an almost universal associate of the nickel silicates, is absent in Oregon. Analyses of these various ores show great dissimilarity in composition, even between specimens from the same deposit. The percentage of nickel oxide varies from 0.24 to 45.15 per cent, but magnesia is present sometimes to the extent of 22 per cent, and this would lead to suspicions that alteration in the olivine, which is a silicate of magnesia and iron, had something to do with it. Actual analyses of the olivine rock confirmed at least the existence of nickel in it, varying in quantity from 0.10 to 0.26 per cent. Mr. Clarke quotes Dr. T. Sterry Hunt as saying that nickel is almost always present in small quantities in olivine, and rarely absent from the serpentines, steatites (soapstones), and allied minerals of the Quebec group. As a result of these investigations, Mr. Clarke concludes that the olivine, which always occurs with these ores, and which so readily alters, has supplied the nickel which is found as silicate, not only in Oregon, but at other localities so far observed.

— Those who are obliged frequently to refer to German books are especially interested in the movement to introduce the Roman in place of the Gothic alphabet. Since 1866 the society which is agitating this matter has nearly doubled in numbers. On its lists are now over 4,436 names, including members of all professions, teachers, physicians, booksellers, and merchants. In 1886, out of 6,913 books on artistic, scientific, mercantile, and industrial subjects, 5,316 were printed with the Roman letters.

— J. N. Emra, late lieutenant Royal Marines, has issued a little book (London, Kegan Paul, Trench, & Co.; New York, the author) descriptive of the cruising of H. M. S. 'Royal Oak' in the waters of the Mediterranean. The author calls his book 'The Centre of the Central Sea,' and devotes himself to Malta, Sicily, and an ascent of Mount Etna by some of the officers, describing the phenomena of the volcano as he saw them.

LETTERS TO THE EDITOR.

Our Native Birds.

AN editorial paragraph in your issue of Aug. 3 assumes that our native birds have this season been unusually abundant; the assumption being based, so far as appears, upon statements "in the New York papers" and upon "information from Illinois," where "the oldest inhabitant does not remember to have seen so many and such a variety of birds." This is good news, — almost too good, — and, for one, I could wish it better vouched for.

In this part of the country, according to my own observations (and I have never been more in the field than this year), there has been no such state of things, either during the migratory movement or since. There are days in April, and again in May, as every ornithologist knows, when the woods and fields are fairly alive with migrants. That was true this year, but no truer than it is every year.

This piece of negative evidence proves nothing, of course; and I should hardly have thought it worth offering had even one ornithologist been named as authority for the fact in question. But in such matters mere newspaper reports seem to me of small account, while my acquaintance with the oldest inhabitant of Massachusetts does not incline me to put unqualified faith in the opinions of the oldest inhabitant of Illinois as to the comparative abundance either of individual birds or of species.

In short, I am suspicious of the testimony, and therefore of the facts; but if the facts can be established, then I join you in hoping that the editors of the *Auk* will favor us with an explanation. As for the one already suggested (by "the New York papers," as I infer), it is plainly insufficient, in more ways than one. If the English sparrows were largely or wholly destroyed, it would be an occasion for thankfulness (I speak for myself); but the supposition that their destruction in March would be followed by a great increase in the number of our native birds within two or three months seems to me very unreasonable. BRADFORD TORREY.

Melrose Highlands, Mass., Aug. 5.

REFERRING to the editorial note in your issue of Aug. 3, the failure of ornithological journals to comment on the apparent increase in bird-life during the present season is perhaps an evidence that such comment is uncalled for. It is true that during the vernal migration there was at one time an unusually heavy 'wave' of migrants, the north-bound stream being held in check for several successive days by unfavorable weather. This obstacle being removed, and pleasant weather succeeding, there resulted an overflow of past-due birds, which flooded the country in such accumulated numbers as to excite remark by the most unobservant, as the numerous articles in the daily press of that period will testify.

The migration over, and our avifauna being sifted down to purely summer resident species, a comparison of the number present with those of preceding years yields, so far as my own observations go, remarkably similar results. To illustrate: I find recorded in my note-book on Aug. 5, 1886, observations on thirty-one species observed during a morning's walk. Of these, eight are given as 'common,' three as 'tolerably common,' and the balance as 'two or three,' 'three or four,' etc.; and on Aug. 7, 1887, thirty-five species, of which ten are recorded as 'common,' ten as 'tolerably common,' and the balance as in the preceding; while on Aug. 5, 1888, the result of a walk over exactly the same district was thirty-three species, ten being 'common,' three 'tolerably common,' and the balance as before.

Local observations of this nature, however, can do little more than assist in making a whole, and only from a mass of comparative data can we assert that the number of individuals composing our avifauna during the present year is greater or less than in years preceding. FRANK M. CHAPMAN.

Englewood, N.J., Aug. 5.

The Relation between the Sourness of Certain Acid Solutions and the Amount of Acid contained.

THE experiments recorded below are a continuation of some studies on the delicacy of the special senses, by Prof. E. L. Nichols and myself and Mr. E. C. Franklin and myself, the results of which have appeared in *Science*, *Nature*, the Proceedings of the Kansas Academy of Science, and elsewhere. By these investiga-

tions the present line of inquiry was suggested. The question raised was, have all acids that have the same alkali-neutralizing strength the same sourness to the taste? For purposes of testing, a number of 'normal' solutions were made. Thus, for

Sulphuric	acid, 1	litre	contained	49.0	grams.
Hydrochloric	"	"	"	"	36.5	"
Nitric	"	"	"	"	63.0	"
Tartaric	"	"	"	"	75.0	"
Citric	"	"	"	"	64.0	"
Acetic	"	"	"	"	60.0	"

The solutions were then of such strength that one cubic centimetre of each would exactly neutralize one cubic centimetre of a normal solution of carbonate of soda.

These solutions were then diluted so that in each series one bottle was of one-half the strength of the preceding one. Of course, a point is soon reached where the acid is so dilute that it is impossible to recognize its presence by the sense of taste. The bottles containing these acids, and some bottles containing only water, were placed without regard to order, and the experimenter was requested to separate into two groups acid and water by tasting the solutions. Those who had the sense of taste more thoroughly developed would be expected to taste the more dilute of the acids. No attempt was made to distinguish between the different kinds of acids. The best method has been found to be to test the solutions rapidly, and pick out the samples about which there could be no doubt, and then to go more carefully over the rest a second time.

In order to obtain the average taste, tests were made by twenty persons, including both sexes and different ages. As the acids are of different apparent strength, the solution of the acids is best seen by a comparison of the most dilute solution tasted in order of strength. This can best be shown by a comparison of the numbers of bottles tested; viz., —

Sulphuric	acid,	7.2	Tartaric	acid,	6.5
Hydrochloric	"	7.0	Citric	"	6.8
Nitric	"	7.1	Acetic	"	6.8

These results agree as closely as could be expected, especially when we consider the unprejudiced position of the experimenter. It will be noticed that the general average of the mineral is a little higher than that of the organic acids. This may be due to a more persistent and characteristic taste in the former. There seemed to be greater uniformity in the tests for sulphuric acid than for any other, as only four detected any acid in the eighth dilution, and none failed to notice it in the seventh. The amount of acid detected, of course, varies with the molecular weights, but the average limit of delicacy is about one part in two thousand parts of water.

For these tests the solutions were frequently renewed. In one case they were allowed to stand for three weeks, when it was found that the three organic acids had lost about all their strength, and at the same time a variety of microscopic organisms had developed at the expense of the acid. These algæ were different in each acid, though some of the same species were found in all. The examination was kindly made by my friend Mr. V. L. Kellogg. It may not be in place to give here the details of this examination, but only to suggest that a great field of investigation lies open in the direction of these lower orders of life and their relation to the destruction of chemically pure substances.

In conclusion, it seems to be true, from what has been stated above, that all acids having the same alkali-neutralizing power are equally sour to the taste, and that the solutions of organic acids rapidly lose their strength. E. H. S. BAILEY.

Lawrence, Kan., July 27.

Beware of the Deadly Alternating Electric Current.

AT the School of Mines of Columbia College this morning, at eleven o'clock, experiments were undertaken, at the request of Harold P. Brown, electrical engineer, to determine the danger of alternating currents, by Dr. Cyrus Edson and Dr. Charles F. Roberts of the New York Board of Health.

The first dog operated upon was a mongrel dog weighing 61 pounds, strong, and in good condition. His height was 24 inches; length from tip of nose to base of tail, 42 inches; and resistance from the right front leg to the left hind leg, 14,000 ohms. Connection was made by binding a piece of cotton waste saturated with water round the leg with No. 20 bare copper wire. The dog was placed in a cage, and the alternating current applied by Dr. Roberts at 272.16 volts for five seconds; number of alternations, 288 per second. The dog was silent and motionless during the continuance of the current. He gave a few spasmodic gasps thirty-one seconds after current was first applied, and heart ceased beating ninety seconds after current was applied. The dog was immediately dissected by Dr. Roberts and Dr. Peterson, and section of sciatic and pneumogastric nerves, muscular fibres of diaphragm, and lungs, placed under a microscope, and no changes in structure were observed.

The second dog was a full-blooded Newfoundland, strong, and in good condition, weighing 91 pounds; length from tip of nose to base of tail, 48 inches; height, 25 inches; resistance, 8,000 ohms. Connection was made in the same manner as above. Alternating current applied by Dr. Roberts at 340.5 volts electro-motive force for five seconds. The dog was silent and motionless during continuance of current, howled and gasped for eight seconds after circuit was opened; but, in the opinion of physicians present, this was pure mechanical action, as the dog was unconscious from the instant the current first reached him. Heart stopped beating in two minutes and fifty seconds after current was first applied.

The third dog was a half-breed setter and Newfoundland, weighing 53 pounds, 42 inches long from tip of nose to base of tail, and 24 inches high; resistance, 30,000 ohms. Connections were made in the same way as before. Dr. Roberts applied the alternating current at 220 volts for five seconds. The result was not fatal at four minutes afterwards. Mr. Porter, superintendent of machinery of Columbia College, then suggested, that, as the dog was rigid and motionless during the continuance of the shock, it would be impossible for a man in the same conditions to utter a sound or to break the contact in five seconds. Dr. Edson then determined to administer the current at same number of volts for thirty seconds on this account, and on account of the high resistance of this subject. This was done, and during the period of the thirty seconds the voltage rose to 234. The dog died instantly without sound or struggle. The resistance after death was found to be 2,800 ohms.

All the physicians present expressed the opinion that a dog had a higher vitality than a man, and that therefore a current which killed a dog would be fatal to a man under the same conditions. It was their opinion that all of these deaths were painless, as the nerves were probably destroyed in less time than that required to transmit the impression to the brain of the subject.

Dr. Edson invited Prof. Elihu Thomson of Boston, and Dr. Otto A. Moses, to be present with measuring-instruments to check up the voltage, etc.; but neither of these gentlemen put in an appearance or responded.

Dr. CYRUS EDSON, *Pres. Board of Health.*
Dr. CHARLES F. ROBERTS, *Asst. Prof. Physiol., Bellevue Hospital Medical College.*
Dr. FREDERICK PETERSON.
Dr. FRANK H. INGRAM.
Dr. H. A. HAUBALD.
Dr. SCHUYLER S. WHEELER, *Electrician Board of Electrical Control.*
HAROLD P. BROWN, *Electrical Engineer.*
Mr. JOHN MURRAY MITCHELL.
Prof. C. E. COLBY, Columbia College.
Capt. E. L. ZALINSKI, U.S.A.
Prof. L. H. LAUDY, Columbia College.

New York, Aug. 3.

Note on Breeding-Habits of the Bill-Fish (Tylosurus longirostris).

ON the 25th of June last my attention was called by Mr. Ulric Dahlgren of this city to the fact that very young specimens of the bill-fish were to be found in large numbers in the 'feeder' of the Delaware and Raritan Canal, north of the town. A few days later I obtained many specimens, and their size at once showed that they had been hatched at the locality where found. In fact, many still showed traces of the yolk-sac.

So far as I have been able to ascertain, there has been no previous record of the fact that this fish breeds in fresh water, the impression with ichthyologists being that they never deposited their eggs beyond salt-water limits. CHARLES C. ABBOTT.

Trenton, N.J., July 31.

Publications received at Editor's Office, July 30–Aug 11.

CLARKE, F. W. The Constants of Nature. Part I. A Table of Specific Gravity for Solids and Liquids. Washington, Smithson. Inst. 409 p. 8°.
EMRA, J. N. The Centre of the Central Sea. London, Kegan Paul, Trench, & Co. 63 p. 16°. 25 cents.
INSECT Life. Vol. I. No. 1, July, 1888. *m.* Washington, Government. 32 p. 8°.
MERIAM, H. C. Footprints of a Profession; or, Ethics in Materials and Methods. 2d ed. St. Louis, Mo., Dental Journ. and Lib. Assoc. 30 p. 8°.
PACKARD, A. S. Entomology for Beginners. New York, Holt. 367 p. 12°.
SWAIN, G. F. Statistics of Water Power employed in manufacturing in the United States. (Amer. Statist. Assoc., new ser. No. 1.) Boston, W. J. Schofield, Pr. 44 p. 8°. 75 cents.
THICKSTUN, F. A Mexican Girl Boston, Ticknor. 237 p. 16°. 50 cents.

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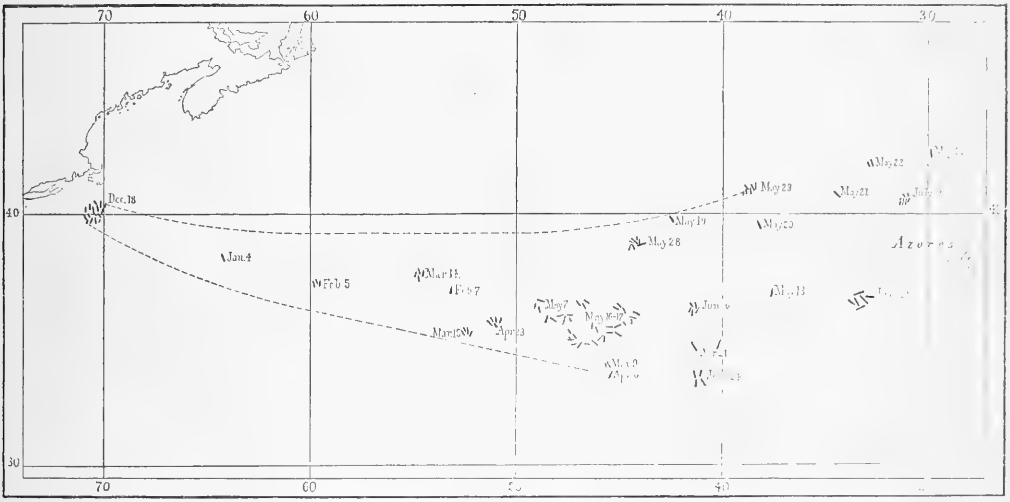
Wants.

SCIENCE

FRIDAY, AUGUST 17, 1888.

THE PILOT CHART of the North Atlantic Ocean for August, issued by the Hydrographic Office under direction of Commodore John G. Walker, chief of Bureau of Navigation, is accompanied by a supplement containing a large amount of useful and interesting information concerning derelicts and wreckage on the high seas, with a graphic and complete record of the tracks followed by some of the most notable derelicts reported on back numbers of the chart. Most noticeable of all, and of especial interest at the present time, is the complete history, up to date, of the great log raft abandoned off Nantucket last December, with a tabular statement of every report received from masters of vessels since that time, of logs from the great raft. This table contains 134 reports, and although a few of them relate to timber from vessels' deck loads, yet the great majority are undoubtedly reports of fragments of the log raft. The graphic representation of the manner in which these obstructions to navigation have spread over the Atlantic is very impressive: their general drift was at first about south-east, under the influence of the prevailing north-westerly winds, and then almost due east in the Gulf Stream, the plotted tracks reaching well over to the Azores, where, indeed, one of the logs was towed into port on June 14, according to the United States consul at Fayal. Some of them are now to the northward of the Azores, drifting north-easterly, and others to the southward, drifting south-easterly, and of the former some may yet reach the shores of Europe. A considerable amount of driftwood was observed farther north, but, from the descriptions, it appears that it did not belong to the raft. That portion of the map referring to the gradual dispersion of this mass of timber has been reproduced above.



The almost world-wide notoriety achieved by this great log raft lends emphasis to the following remarks, quoted from the chart itself: "To the student of ocean currents, it is interesting to watch the tracks which the scattered logs from this great raft have followed, drifting, as they do, under the combined and varying influence of wind, tide, and current, and every log offering some slight difference of resistance to each, according to its size, weight, and depth of flotation. To the practical navigator, however, it will be of still greater interest to have logs shipped in the usual way, or at least more securely than was done in this case, in order that dangerous obstructions may not be added in this wholesale manner to those which, in the ordinary course of things, he has to guard against." The tracks of derelict vessels are also of great interest, and clearly illustrate how long these dangerous obstructions often remain afloat. For instance, one of them drifted 2,800 miles, and another the enormous distance of 3,500 miles (from off the capes of Chesapeake Bay to the Bay of Biscay, by a circuitous route).

The Hydrographic Office, of which Lieut. G. L. Dyer, U.S.N., is now in charge, is enabled to collect and publish data of this kind in complete and reliable form by means of the facilities of the branch hydrographic offices established in our principal seaports, the establishment of which has been of the greatest assistance to our mercantile marine, and has greatly strengthened the navy in their estimation. The Pilot Chart itself for August shows a new feature, which will make it of still greater value. It contains the tracks of all the notable August hurricanes on record, thus indicating at a glance both the regions where they are liable to be encountered and the general direction of the paths which they follow. A descriptive article on the chart calls attention to the fact that August is the great hurricane month, and describes the tracks followed by the two memorable hurricanes of August of last year, one of which is perhaps the most notable on record, beginning near the Cape Verde Islands, off the coast of Africa, and thence traversing the entire ocean to the westward, curving to the northward past Cape Hatteras, and thence about east-north-east across the Grand Banks, and re-crossing the Atlantic towards the British Isles and northern Norway. In this way the good work of the office is kept up.

THE INTERNATIONAL CONGRESS OF AMERICANISTS.

IT is now two years since the sixth meeting of the International Congress of Americanists was held at Turin. The next meeting is going to be held at Berlin from the 2d to the 5th of October. Before the adjournment of the Turin meeting an organizing committee was appointed, which, in agreement with the bureau of the Turin session, proposes the following subjects for the discussion of the congress. The first day of the meeting will be devoted to the history of the discovery of America, to the pre-Columbian history of the continent, and to American geology. Among the important subjects proposed for this day is a discussion of the early history of Central America, more particularly of the nationalities living there before the invasion of the Aztecs and other northern tribes, and of the chronology of the invasions of uncivilized tribes into Mexico. Professor Guido Cora of Turin will report on the publication of documents referring to Columbus, incident to the celebration of the fourth centenary of the discovery of America, and on the origin of the name of America. Mr. Gelcich, who recently published in the Journal of the Berlin Geographical Society an elaborate study of the life of Columbus, will report on recent researches in this field.

The second day will be devoted to the discussion of archæological questions. Of course, the most prominent of these is the comparison of American and Asiatic relics; and the similarity and dissimilarity of American and Asiatic jade implements and pottery will be discussed.

On the third day the anthropology and ethnology of America will be treated. Prof. R. Virchow will report on the anthropologic classification of the ancient and modern inhabitants of America and on a craniological atlas. It is to be hoped that this important work will be materially furthered by the researches of the congress. Another problem not inferior in importance to the former is that of the ethnological atlas of America, to which the Bureau of Ethnology of Washington has made a contribution of the greatest value. While the discussion of the congress will hardly add any thing to the facts referring to North America collected by the scientists at Washington, our knowledge of the distribution of tribes of South America will undoubtedly be materially increased. While these two questions refer to material to be collected, a number of others will treat the ethnological problems of our continent. Prof. A. Bastian will illustrate the theory of geographical provinces by the ethnology of America. Profs. C. Fritsch and Guido Cora will discuss the unity of the American aborigines by studying their anthropological features, and the latter will compare the diluvial human remains with those of the Indians. Professor Virchow will compare the artificial deformations of skulls practised in America with those found in Asia, Europe, and on the islands of the Pacific Ocean. Another problem of general interest will be treated by A. Krause, — the question of a connection between Asiatic races and the natives of the north-west coast of America.

The last day of the session will be devoted to linguistics and paleography. The question will be discussed whether there exists any characteristic feature common to all American languages. Another subject of general interest, upon which Prof. L. Steinthal will make a report, is the question if any similarity exists between Polynesian and north-west American languages.

A detailed programme will be published about the middle of September, and members are requested to send their manuscripts, or the titles of their communications, to the bureau of the congress before Sept. 15. The bureau is in the Royal Ethnological Museum of Berlin, which will also form one of the principal attractions of the coming congress. There are few collections in Europe which represent the ethnology of America so well as that of Berlin, and none has collections of equal value from the civilized races of ancient America. Fortunately the collections have been recently transferred to a new and magnificent building, where they will be accessible to the visitors of the congress. There are a number of old collections from the central part of South America showing the beautiful feather-work of the Indians of those regions, but the student will principally be interested in Von den Steinen's collections from the Xingu River. This distinguished explorer will report to the congress on his recent expedition, from which he has just returned. The ancient civilization of Peru, which forms one of the objects of discussion, is represented by valuable collections in the museum, particularly the great collection of pottery and gold ornaments of Macedo and that of Reiss and Stübel, which contains, besides specimens of pottery, numerous mummies, beautiful samples of woven clothing, etc. The collections from Central America date back to the travels of Alexander von Humboldt; but since that time numerous new collections have been added, principally those of Bastian and of Strebel. Last, we have to mention the extensive collections from British Columbia and Alaska.

It is to be expected that the approaching congress will materially further the study of American archæology and ethnology.

THE HISTORY OF A DOCTRINE.[1]

"MAN, being the servant and interpreter of nature, can do and understand so much, and so much only, as he has observed, in fact or in thought, of the course of nature. Beyond this he neither knows any thing nor can do any thing." — BACON'S *Novum Organum*, aphorism 1.

IN these days, when a man can take but a very little portion of knowledge to be his province, it has become customary that your president's address shall deal with some limited topic, with which his own labors have made him familiar; and accordingly I have selected as my theme the history of our present views about radiant energy, not only because of the intrinsic importance of the subject, but because the study of this energy in the form of radiant heat is one to which I have given special attention.

Just as the observing youth, who leaves his own household to look abroad for himself, comes back with the report that the world, after all, is very like his own family, so may the specialist, when he looks out from his own department, be surprised to find that, after all, the history of the narrowest specialty is amazingly like that of scientific doctrine in general, and contains the same lessons for us. To find some of the most useful ones, it is important, however, to look with our own eyes at the very words of the masters themselves, and to take down the dusty copy of Newton, or Boyle, or Leslie, instead of a modern abstract; for, strange as it may seem, there is something of great moment in the original that has never yet been incorporated into any encyclopædia, something really essential in the words of the man himself which has not been indexed in any text-book, and never will be.

It is not for us, then, here to-day, to try

> "How index-learning turns no student pale,
> Yet holds the eel of science by the tail;"

but, on the contrary, to remark that from this index-learning, from these histories of science and summaries of its progress, we are apt to get wrong ideas of the very conditions on which this progress depends. We often hear it, for instance, likened to the march of an army toward some definite end; but this, it has seemed to me, is not the way science usually does move, but only the way it seems to move in the retrospective view of the compiler, who probably knows almost nothing of the real confusion, diversity, and retrograde motion of the individuals comprising the body, and only shows us such parts of it as he, looking backward from his present standpoint, now sees to have been in the right direction.

I believe this comparison of the progress of science to that of the army which obeys an impulse from one head has more error than truth in it; and, though all similes are more or less misleading, I would almost prefer to ask you to think rather of a moving crowd, where the direction of the whole comes somehow from the independent impulses of its individual members, not wholly unlike a pack of hounds, which, in the long-run, perhaps catches its game, but where, nevertheless, when at fault, each individual goes his own way by scent, not by sight, some running back and some forward; where the louder-voiced bring many to follow them, nearly as often in a wrong path as in a right one; where the entire pack even has been known to move off bodily on a false scent; for this, if a less dignified illustration, would be one which had the merit of hav-

[1] Address before the American Association for the Advancement of Science, at Cleveland, O., Aug. 15, 1888, by Prof. S. P. Langley, the retiring president of the association.

ing a considerable truth in it, but one left out of sight by the writers of books.

At any rate, the actual movement has been tortuous, or often even retrograde, to a degree of which you will get no idea from the account in the text-book or encyclopædia, where, in the main, only the resultant of all these vacillating motions is given. With rare exceptions, the backward steps — that is, the errors and mistakes, which count in reality for nearly half, and sometimes for more than half, the whole — are left out of scientific history; and the reader, while he knows that mistakes have been made, has no just idea how intimately error and truth are mingled in a sort of chemical union, even in the work of the great discoverers, and how it is the test of time chiefly which enables us to say which is progress when the man himself could not. If this be a truism, it is one which is often forgotten, and which we shall do well to here keep before us.

This is not the occasion to review the vague speculations of the ancient natural philosophers from Aristotle to Zeno, or to give the opinion of the schoolmen on our subject. We take it up with the immediate predecessors of Newton, among whom we may have been prepared to expect some obscure recognition of heat as a mode of motion, but where it has been, to me at least, surprising, on consulting their original works, to find how general and how clear an anticipation of our modern doctrine may be fairly said to exist. Whether this early recognition of the atomic and vibratory theories be a legacy from the Lucretian philosophy, it is not necessary to here consider. The interesting fact, however it came about, is the extent to which seventeenth-century thought is found to be occupied with views which we are apt to think very recent.

Descartes, in 1664, commences his 'Le Monde' by a treatise on the propagation of light, and what we should now call radiant heat, by vibrations, and further associates this view of heat as motion with the distinct additional conception that in the cause of light and radiant heat we may expect to find something quite different from the sense of vision or of warmth; and he expresses himself with the aid of the same simile of sound employed by Draper over two hundred years later. The writings of Boyle on the mechanical production of heat contain illustrations (like that of the hammer driving the nail, which grows hot in proportion as its bodily motion is arrested) which show a singularly complete apprehension of views we are apt to think we have made our own; and it seems to me that any one who consults the originals will admit, that, though its full consequences have not been wrought out till our own time, yet the fundamental idea of heat as a mode of motion is so far from being a modern one, that it was announced in varying forms by Newton's immediate predecessors, by Descartes, by Bacon, by Hobbes, and in particular by Boyle, while Hooke and Huyghens merely continue their work, as at first does Newton himself.

If, however, Newton found the doctrine of vibrations already, so to speak, "in the air," we must, while recognizing that in the history of thought the new always has its root in the old, and that it is not given even to a Newton to create an absolutely new light, still admit that the full dawn of our subject properly begins with him, and admit, too, that it is a bright one, when we read in the 'Optics' such passages as these: —

"Do not all fixed bodies, when heated beyond a certain degree, emit light and shine, and is not this emission performed by the vibrating motions of their parts?" And again: "Do not several sorts of rays make vibrations of several bignesses?" And still again: "Is not the heat conveyed by the vibrations of a much subtler medium than air?"

Here is the undulatory theory; here is the connection of the ethereal vibrations with those of the material solid; here is "heat as a mode of motion;" here is the identity of radiant heat and light; here is the idea of wave-lengths. What a step forward this first one is! And the second?

The second is, as we now know, backward. The second is the rejection of this, and the adoption of the corpuscular hypothesis, with which alone the name of Newton (a father of the undulatory theory) is, in the minds of most, associated to-day.

Do not let us forget, however, that it was on the balancing of arguments from the facts then known that he decided, and that perhaps it was rather an evidence of his superiority to Huyghens, that apprehending before the latter, and equally clearly, the undulatory theory, he recognized also more clearly that this theory as then understood failed utterly to account for several of the most important phenomena.

With an equally judicial mind, Huyghens would perhaps have decided so too, in the face of difficulties, all of which have not been cleared up even to-day.

These two great men, then, each looked around in the then darkness as far as his light carried him. All beyond that was chance to each; and fate willed that Newton, whose light shone farther than his rival's, found it extend just far enough to show the entrance to the wrong way. He reaches the conclusion that we all know; and with the result on other men's thought, that, light being conceded to be material, heat, if affiliated to light, must be regarded as material too, for we may see this strange conclusion drawn from experiments of Herschel a century later.

It would seem that the result of this unhappy corpuscular theory was more far-reaching than we commonly suppose, and that it is hardly too much to say that the whole promising movement of that age toward the true doctrine of radiant energy is not only arrested by it, but turned the other way; so that in this respect the philosophy of fifty years later is actually farther from the truth than that of Newton's predecessors.

The immense repute of Newton as a leader, on the whole so rightly earned, here leads astray others than his conscious disciples, and, it seems to me, affects men's opinions on topics which appear at first far removed from those he discussed. The adoption of phlogiston was, as we may reasonably infer, facilitated by it, and remotely Newton is perhaps also responsible in part for the doctrine of caloric a hundred years later. After him, at any rate, there is a great backward movement. We have a distinct retrogression from the ideas of Bacon and Hobbes and Boyle. Night settles in again on our subject almost as thick as in the days of the schoolmen, and there seems to be hardly an important contribution to our knowledge, in the first part of the eighteenth century, due to a physicist.

"Physics, beware of metaphysics," said Newton, — words which physicists are apt so exclusively to quote, that it seems only due to candor to observe that the most important step, perhaps, in the fifty years which followed the 'Optics,' came from Berkeley, who, reasoning as a metaphysician, gave us during Newton's lifetime a conception wonderfully in advance of his age. Yet the 'New Theory of Vision' was generally viewed by contemporary philosophers as only an amusing paradox, while "coxcombs vanquish[ed] Berkeley with a grin;" and this contribution to science, — an exceptional if not a unique instance of a great physical generalization reached by *a priori* reasoning, — though published in 1709, remains in advance of the popular knowledge even in these closing years of the nineteenth century.

In the mean time a new error had risen among men, — a new truth, as it seemed to them, and a thing destined to have a strong reflex action on the doctrine of radiant energy. It began with the generalization of a large class of phenomena (which we now associate with the action of oxygen, then of course unknown), — a generalization useful in itself, and accompanied by an explanation which was not in its origin objectionable. Let us consider, in illustration, any familiar instance of oxidation, and try to look first for what was reasonable in the eighteenth-century views of the cause of such phenomena.

A piece of dry wood has in it the power of giving out heat and light when set on fire; but after it is consumed there is left of it only inert ashes, which can give neither. Something, then, has left the wood in the process of becoming ashes; virtue has gone out of it, or, as we should say, its potential energy has gone.

This is, so far, an important observation, extending over a wide range of phenomena, and, if it had presented itself to the predecessors of Newton, it would probably have been allied to the vibratory theories, and become proportionately fruitful. But to his disciples, and to chemists and others, who, without being perhaps disciples, were like all then, more or less consciously influenced by the materiality of the corpuscular theory, it appeared that this also was a material emanation, that this energy was an actual ingredient of the wood, — a crudeness of conception which seems most strange to

us, but is not perhaps unaccountable in view of the then current thought.

I have said that the progress of science is not so much that of an army as of a crowd of searchers, and that a call in a false direction may be responded to, not by one only, but by the whole body. In illustration, observe that during the greater part of the entire eighteenth century this doctrine was adopted by almost every chemist and by most physicists. It had quite as general an acceptance among scientific men then as the kinetic theory of gases, for instance, has now, and, so far as time is any test of truth, it was tested more severely than the kinetic theory has yet been; for it was not only the lamp and guide of chemists, and to a great extent of physicists also, but it remained the time-honored and highest generalization of chemico-physical science for over half a century, and it was accepted not so much as a conditional hypothesis as a final guide and a conquest for truth which should endure always. And now where is it? Dissipated so utterly from men's minds, that, to the unprofessional part of even an educated audience like this, 'phlogiston,' once a name to conjure with, has become an unmeaning sound.

There is no need to insist on the application of the obvious moral to hypotheses of our own day. I have tried to recall for a moment all that 'phlogiston' meant a little more than a hundred years ago, partly because it seems to me, that, though a chemical conception, physics is not wholly blameless for it, but chiefly because before it quitted the world it appears to have returned to physics the wrong in a multiplied form by generating an offspring specially inimical to true ideas about radiant heat, and which is represented by a yet familiar term. I mean 'caloric.'

This word is still used loosely as a synonyme for heat, but has quite ceased to be the very definite and technical term it once was. To me it has been new to find that this so familiar word 'caloric,' so far as my limited search has gone, was apparently coined only toward the last quarter of the last century. It is not to be found in the earliest edition of Johnston's Dictionary, and, as far as I can learn, appears first in the corresponding French form in the works of Fourcroy. It expressed an idea which was the natural sequence of the phlogiston theory, and which is another illustration that the evil which such theories do lives after them.

'Caloric' first seemingly appears, then, as a new word coined by the French chemists, and meant originally to signify the unknown cause of the sensation heat, without any implication as to its nature. But words, we know, though but wise men's counters, are the money of fools; and this one very soon came to commit its users to an idea which was more likely to have had its origin in the mind of a chemist at that time than of any other, — the idea of the cause of heat as a material ingredient of the hot body; something not, it is true, having weight, but which it would have been only a slight extension of the conception to think might one day be isolated by a higher chemical art, and exhibited in a tangible form.

We may desire to recognize the perverted truth which usually underlies error, and gives it currency, and be willing to believe that even 'caloric' may have had some justification for its existence; but this error certainly seems to have been almost altogether pernicious for nearly the next eighty years, and down even to our own time. With this conception as a guide to the philosophers of the last years of the eighteenth century, it is not, at any rate, surprising if we find that at the end of a hundred years from Newton the crowd seems to be still going constantly farther and farther away from its true goal.

Although Provost gave us his most material contribution about 1790, we have, it seems to me, on the whole, little to interest us during that barren time in the history of radiant energy called the eighteenth century, — a century whose latter years are given up, till near its very close, to bad *a priori* theories in our subject, except in the work of two Americans; for in the general dearth at this time, of experiments in radiant heat, it is a pleasure to fancy Benjamin Franklin sitting down before the fire, with a white stocking on one leg and a black one on the other, to see which leg would burn first, and to recall again how Benjamin Thompson (Count Rumford) not only weighed 'caloric' literally in the balance and found it wanting, but made that memorable experiment in the Munich founderies which showed that heat was perpetually and without limit created from motion.

It was in the last years of the century, too, that he provided for the medal called by his name, and which, though to be given for researches in heat and light, has, I believe, been allotted in nearly every instance to men, who, like Leslie, Malus, Davy, Brewster, Fresnel, Melloni, Faraday, Arago, Stokes, Maxwell, and Tyndall, have contributed toward the subject of radiant energy in particular.

We observe that till Rumford's time the scientific literature of the century scarcely considers the idea even of radiant heat, still less of radiant energy; so that we have been obliged here to discuss the views of its physicists about heat in general, heat and light in most eighteenth-century minds being distinct entities. We must remember, then, to his greater honor, that the idea of radiant heat as a separate study has before Rumford scarcely an existence; all the ways for pilgrims to this special shrine of truth being barred, like those in Bunyan's allegory, by two unfriendly monsters who are called Phlogiston and Caloric, so that there are few scientific pilgrims who do not pay them toll.

The doctrine of caloric is, however, even then recognized as a chemical hypothesis rather than one acceptable to physicists, some of whom still stand out for vibratory theories even through the darkest years of the century; and, further, we may find, on strict search, that the old idea of heat as a mode of motion has not so utterly died that it does not appear here and there during the last century, not only among philosophers, but even in a popular form.

In an old English translation of Father Regnault's compilation on physics, dated about 1730, I find the most explicit statement of the doctrine of heat as a mode of motion. Here heat is defined (with the aid of a simile due, I believe, to Boyle) as "any Agitation whatever of the insensible parts. Thus a Nail which is drove into the Wood by the stroke of a Hammer does not appear to be hot, because its immediate parts have but one common Movement. But should the Nail cease to drive, it would acquire a sensible Heat, because its insensible Parts which receive the Motion of the Hammer now acquire an agitation every way rapid." We certainly must admit that the user of this illustration had just and clear ideas; and the interesting point here appears to be, that as Father Regnault's was not an original work, but a mere compendium or popular scientific treatise of the period, we see, if only from this instance, that the doctrine of heat as a mode of motion was not confined to the great men of an earlier or a later time, but formed a part of the common pabulum during the eighteenth century to an extent that has been singularly forgotten.

The last years of the eighteenth century were destined to see the most remarkable experiments in heat made in the whole of the hundred; for the memoir of Rumford appeared in the Philosophical Transactions for 1798; and in the very year 1800 appeared in the same place Sir William Herschel's paper, in which he describes how he placed a thermometer in successive colors of the solar spectrum, finding the heat increase progressively from the violet to the red, and increase yet more beyond the red where there was no color or light whatever; so that there are, he observes, invisible rays as well as visible. More than that, the first outnumber the second; and these dark rays are found in the very source and fount of light itself. These dark rays can also be obtained, he observes, from a candle or a piece of non-luminous hot iron, and, what is very significant, they are found to pass through glass, and to be refracted by it like luminous ones.

And now Herschel, searching for the final verity through a series of excellent experiments, asks a question which shows that he has truth, so to speak, in his hands, — he asks himself the great question whether heat and light be occasioned by the same or different rays.

Remember the importance of this (which the querist himself fully recognized); remember, that, after long hunting in the blindfold search, he has laid hands, as we now know, on the truth herself, and then see him — let go. He decides that heat and light are not occasioned by the same rays, and we seem to see the fugitive escape from his grasp, not to be again fairly caught till the next generation.

I hardly know more remarkable papers than these of Herschel's in the Philosophical Transactions for 1800, or any thing more instructive in little men's successes than in this great man's failure, which came in the moment of success. I would strongly recom-

mend the reading of these remarkable original memoirs to any physicist who knows them only at second-hand.

One more significant lesson remains, in the effect of this on the minds of his contemporaries. Herschel's observation is to us almost a demonstration of the identity of radiant heat and light; but now, though the nineteenth century is opening, it is with the doctrine still in the minds of most physicists, and perhaps of all chemists, that heat is occasioned by a certain material fluid. Phlogiston is by this time dead or dying, but caloric is very much alive, and never more perniciously active than now, when, for instance, years after Herschel's observation, we find this cited as "demonstrating the existence of caloric," which was, it seems, the way it looked to a contemporary.

In the year 1804 appeared what should be a very notable book in the history of our subject, written by Sir John Leslie, whose name survives perhaps in the minds of many students chiefly in connection with the 'cube,' which is still called after him.

Leslie, however, ought to be remembered as a man of original genius, worthy to be mentioned with Herschel and Melloni; and his, too, is one of the books which the student may be recommended to read, at least in part, in the original; not so much for the writer's instructive experiments (which will be found in our text-books) as for his most instructive mistakes, which the text-book will probably not mention.

He began by introducing the use of the simple instrument which bears his name, and a new and more delicate heat-measure (the differential thermometer); and with these, and concave reflectors of glass and metal, he commenced experiments in radiant heat, than which, he tells us, no part of physical science then appeared so dark, so dubious, and so neglected. It is interesting, and it marks the degree of neglect he alludes to, that his first discovery was that different substances have different radiating and absorbing powers. It gives us a vivid idea of the density of previous ignorance, that it was left to the present century to demonstrate this elementary fact, and that Leslie, in view of such discoveries, says, "I was transported at the prospect of a new world emerging to view."

Next he shows that the radiating and absorbing powers are proportional, next that cold as well as heat seems to be radiated, and next undertakes to see whether this radiant heat has any affinity to light.

He then experiments in the ability of radiant heat to pass through a transparent glass, which transmits light freely, and thinks he finds that none does pass. Radiant heat with him seems to mean heat from non-luminous sources; and the ability or non-ability of this to pass through glass is to Leslie and his successors a most crucial test, and its failure to do so a proof that this heat is not affiliated to light.

Let us pause a moment here to reflect that we are apt to unconsciously assume, while judging from our own present standpoint where past error is so plain, that the false conclusion can only be chosen by an able, earnest, conscientious seeker, after a sort of struggle. Not so. Such a man is found welcoming the false with rapture as very truth herself.

"What, then," says Leslie, "is this calorific and frigorific fluid after which we are inquiring? It is not light, it has no relation to ether, it bears no analogy to the fluids, real or imaginary, of magnetism and electricity. But why have recourse to invisible agents? *Quod petis, hic est.* It is merely the ambient AIR."

The capitals are Leslie's own, but ere we smile with superior knowledge let us put ourselves in his place, and then we may comprehend the exultation with which he announces the identity of radiant heat and common air, for he feels that he is beginning a daring revolt against the orthodox doctrine of caloric; and so he is.

The first five years of this century are notable in the history of radiant energy, not only for the work of Leslie, and for the observation by Wollaston, Ritter, and others, of the so-called 'chemical' rays beyond the violet, but for the appearance of Young's papers, re-establishing the undulatory theory, which he indeed considered in regard to light, but which was obviously destined to affect most powerfully the theory of radiant energy in general.

We are now in the year 1804, or over a century and a quarter since the corpuscular theory was emitted, and during that time it has gradually grown to be an article of faith in a sort of scientific church, where Newton has come to be looked on as an infallible head, and his views as dogmas, about which no doubt is to be tolerated; but if we could go back to Cambridge in the year 1668, when the obscure young student, in no way conscious of his future pontificate, takes his degree (standing twenty-third on the list of graduates), we should probably find that he had already elaborated certain novel ideas about the undulatory theory of light, which he at any rate promulgates a few years later, and afterward, pressed with many difficulties, altered, as we now know, to an emissive one.

Probably, if we could have heard his own statement then, he would have told how sorely tried he was between these two opinions, and, while explaining to us how the wavering balance came to lean as it did, would have admitted, with the modesty proper to such a man, that there was a great deal to be said on either side. We may, at any rate, be sure that it would not be from the lips of Newton himself that we should have had this announced as a belief which was to be part of the rule of faith to any man of science.

But observe how, if science and theology look askance at each other, it is still true that some scientific men and some theologians have, at any rate, more in common than either is ready to admit; for at the beginning of this century Newton's followers, far less tolerant than their master, have made out of this modest man a scientific pontiff, and out of his diffident opinions a positive dogma, till, as years go on, he comes to be cited as so infallible that a questioning of these opinions is an offence deserving excommunication.

This has grown to be the state of things in 1804, when Young, a man possessing something of Newton's own greatness, ventures to put forward some considerations to show that the undulatory theory may be the true one, after all. But the prevalent and orthodox scientific faith was still that of the material nature of light; the undulatory hypothesis was a heresy, and Young a heretic. If his great researches had been reviewed by a physicist or a brother worker, who had himself trodden the difficult path of discovery, he might have been treated at least intelligently; but then, as always, the camp-followers, who had never been at the front, shouted from a safe position in the rear to the man in the dust of the fight, that he was not proceeding according to the approved rules of tactics; then, as always, these men stood between the public and the investigator, and distributed praise or blame.

If you wish to hear how the scientific heretic should be rebuked for his folly, listen to one who never made an observation, but, having a smattering of every thing books could teach about every branch of knowledge, was judged by himself and by the public to be the fittest interpreter to it, of the physical science of his day. I mean Henry Brougham, the future lord-chancellor of England, the universal critic, of whom it was observed, that, "if he had but known a little law, he would have known a little of every thing." He uses the then all-powerful *Edinburgh Review* for his pulpit, and notices Young's great memoir as follows: —

"This paper contains nothing which deserves the name either of experiment or discovery; and it is, in fact, destitute of every species of merit. . . . The paper which stands first is another lecture, containing more fancies, more blunders, more unfounded hypotheses, more gratuitous fictions . . . and all from the fertile yet fruitless brain of the eternal Dr. Young. In our second number we exposed the absurdity of this writer's 'law of interference,' as it pleases him to call one of the most incomprehensible suppositions that we remember to have met with in the history of human hypotheses."

There are whole pages of it, but this is enough; and I cite this passage among many such at command, not only as an example of the way the undulatory theory was treated at the beginning of this century in the first critical journal of Europe, but as another example of the general fact that the same thing may appear intrinsically absurd, or intrinsically reasonable, according to the year of grace in which we hear of it. The great majority, even of students of science, must take their opinions ready-made as to science in general; each knowing, so far as he can be said to know any thing at first-hand, only that little corner which research has made specially his own.

The moral we can all draw, I think, for ourselves.

In spite of such criticism as this, the undulatory hypothesis of light made rapid way, and carried with it, one would now say, the necessary inference that radiant heat was due to undulations also. This was, however, no legitimate inference to those to whom radiant heat was still a fluid; and yet, in spite of all, the modern doctrine now begins to make visible progress.

A marked step is taken about 1811 by a young Frenchman, De la Roche, who deserves to be better remembered than he is, for he clearly anticipated some of Melloni's discoveries. De la Roche in particular shows that of two successive screens the second absorbs heat in a less ratio than the first; whence he, before any one else, I believe, derives the just and most important, as well as the then most novel conception, that radiant heat is of different kinds. He sees also, that, as a body is heated more and more, there is a gradual and continual advance not only in the amount of heat it sends out, but in the kind, so that, as the temperature still rises, the radiant heat becomes light by imperceptible gradations; and he concludes that heat and light are due to one simple agent, which, as the temperature rises yet more, appears more and more as light, or which, as the luminous radiation is absorbed, re-appears as heat. Very little of it, he observes, passes even transparent screens at low temperatures, but more and more does so as the temperature rises.

All this is a truism in 1888, but it is admirably new as well as true in 1811; and if De la Roche had not been removed by an early death, his would have not improbably been the greatest name of the century in the history of our subject; an honor, however, which was in fact reserved for another.

The idea of the identity of light and radiant heat had by this time made such progress that the attempt to polarize the latter was made in 1818 by Berard. We have just seen in Herschel's case how the most sound experiment may lead to a wrong conclusion, if it controverts the popular view. We now have the converse of this in the fact that the zeal of those who are really in the right way may lead to unsound and inconclusive experiment; for Berard experimentally established, as it was supposed, the fact that obscure radiant heat can be polarized. So it can, but not with such means as Berard possessed, and it was not till a dozen years more that Forbes actually proved it.

At this time, however fairly we seem embarked on the paths of study which are followed to-day, and while the movement of the main body of workers is in the right direction, it is yet instructive to observe how eminent men are still spending great and conscientious labor, their object in which is to advance the cause, while the effect of it is to undo the little which has been rightly done, and to mislead those who have begun to go right.

As an instance both of this and of the superiority of modern apparatus, we may remark, — after having noticed that the ability of obscure heat to pass through glass, if completely established, would be a strong argument in favor of its kinship to light, and that De la Roche and others had indicated that it would do so (in which we now know they were right), — that at this stage, or about 1816, Sir David Brewster, the eminent physicist, made a series of experiments which showed that it would not so pass. Ten years later, in view of the importance of the theoretical conclusion, Baden Powell repeated his observations with great care, and confirmed them, announcing that the earlier experimenters were wrong, and that Brewster was right.

Here all these years of conscientious work resulted in establishing, so far as it could be established, a wholly wrong conclusion in place of a right one already gained. It may be added, that, with our present apparatus, the passage of obscure radiant heat through glass could be made convincingly evident in an experiment which need not last a single second.

We are now arrived at a time when the modern era begins; and in looking back over one hundred and fifty years, from the point of view of the experimenter himself, with his own statement of the truth as he saw it, we find that the comparison of the progress of science to that of an army, which moves, perhaps with the loss of occasional men, but on the whole victoriously and in one direction, is singularly misleading; and I state this more confidently here, because there are many in this audience who did not get their knowledge of nature from books only, but who have searched for the truth themselves; and, speaking to them, may I not say that those who have so searched know that the most honest purpose and the most patient striving have not been guaranties against mistakes, — mistakes which were probably hailed at the time as successes? It was some one of the fraternity of seekers, I am sure, who said, "Show me the investigator who has never made a mistake, and I will show you one who has never made a discovery."

We have seen the whole scientific body, as regards this particular science of radiant energy, moving in a mass, in a wrong direction, for a century; we have seen that individuals in it go on their independent paths of error; and we can only wonder that an era should have come in which such a real advance is made as in ours.

That era has been brought in by the works of many, but more than by any other through the fact that in the year 1801 there came into the world at Parma an infant who was born a physicist, as another is born a poet; nay, more; who was born, one might say, a devotee of one department of physics, — that of radiant heat; being affected in his tenderest years with such a kind of precocious passion for the subject as the childish Mozart showed for music. He was ready to sacrifice every thing for it; he struggled through untold difficulties, not for the sake of glory or worldly profit, but for radiant heat's sake; and when fame finally came to him, and he had the right to speak of himself, he wrote a preface to his collected researches, which is as remarkable as any thing in his works. In this preface he has given us, not a summary of previous memoirs on the subject, not a table of useful factors and formulæ, not any thing at all that an English or American scientific treatise usually begins with, but the ingenuous story of his first love, of his boyish passion for this beloved mistress; and all this with a trust in us his readers which is beautiful in its childlike confidence in our sympathy.

I must abbreviate and injure in order to quote; but did ever a learned physical treatise and collection of useful tables begin like this before?

"I was born at Parma, and when I got a holiday used to go into the country the night before and go to bed early, so as to get up before the dawn. Then I used to steal silently out of the house, and run, with bounding heart, till I got to the top of a little hill, where I used to set myself so as to look toward the East." There, he tells us, he used, in the stillness of nature, to wait the rising sun, and feel his attention rapt, less with the glorious spectacle of the morning light itself than with the sense of the mysterious heat which accompanied its beams, and brought something more necessary to our life and that of all nature than the light itself.

The idea that not only mankind, but nature, would perish though the light continued, if this was divorced from heat, made a profound impression, he tells us, on his childish mind.

The statement that such an idea could enter with dominating force into the mind of a child will perhaps seem improbable to most. It will, however, be comprehensible enough to some here, I have no doubt.

Is there some ornithologist present who remembers a quite infantile attraction which birds possessed for him above all the rest of the animated creation; some chemist whose earliest recollections are of the strange and quite abnormal interest he found as a child in making experimental mixtures of every kind of accessible household fluid and solid; some astronomer who remembers when a very little creature that not only the sight of the stars, but of any work on astronomy, even if utterly beyond his childish comprehension, had an incomprehensible attraction for him?

I will not add to the list. There are, at any rate, many here who will understand and believe Melloni when he tells how this radiant heat, commonplace to others, was wonderful to his childish thought, and wrought a charm on it such that he could not see wood burn in a fireplace, or look at a hot stove, without its drawing his mind, not to the fire or iron itself, but to the mysterious effluence which it sent.

This was the youth of genius; but let not any fancy that genius in research is to be argued from such premonitions alone, unless it can add to them that other qualification of genius which has caused it to be named the faculty of taking infinite pains. Melloni's subsequent labors justified this last definition also; but I cannot speak of them here, further than to say, that after going over a large part of his work myself, with modern methods and with better apparatus,

he seems to me the man, of all great students of our subject, who, in reference to what he accomplished, made the fewest mistakes.

Melloni is very great as an experimenter, and owes much of his success to the use of the newly invented thermopile, which is partly his own. I can here, however, speak only of his results, and of but two of these, — one generally known; the other, and the more important, singularly little known, at least in connection with him.

The first is the full recognition of the fact, partly anticipated by De la Roche, that radiant heat is of different kinds, that the invisible emanations differ among themselves just as those of light do. Melloni not only established the fact, but invented a felicitous term for it, which did a great deal to stamp it on recognition, — the term 'thermochrose,' or heat-color, which helps us to remember, that, as the visible and apparently simple emanation of light is found to have its colors, so radiant heat, the invisible but apparently simple emanation, has what would be colors to an eye that could see them. This result is well known in connection with Melloni.

The other and the greater, which is not generally known as Melloni's, is the generalization that heat and light are effects of one and the same thing, and merely different manifestations of it. I translate this important statement as closely as possible from his own words. They are that

"*Light is merely a series of calorific indications sensible to the organs of sight, or Vice Versa, the radiations of obscure heat are veritable* INVISIBLE RADIATIONS *of light*."

The Italics and the capitals are Melloni's own.

He wishes to have no ambiguity about his announcement behind which he may take shelter; and he had so firm a grasp of the great principle, that, when his first attempts to observe the heat of the moon failed, he persevered, because this principle assured him that where there was light there must be heat. This statement was made in 1843, and ought, I think, to insure to Melloni the honor of being first to distinctly announce this great principle.

The announcement passed apparently unnoticed, in spite of his acknowledged authority; and the general belief not merely in different entities in the spectrum, but in a material caloric, continued as strong as ever. If you want to see what a hold on life error has, and how hard it dies, turn to the article 'Heat,' in the eighth edition of the 'Encyclopædia Britannica,' where you will find the old doctrine of caloric still in possession of the field in 1853; and still later, in the generally excellent 'English Encyclopædia' (edition of 1867), the doctrine of caloric is, on the whole, preferred to the undulatory hypothesis. It is very probable that a searcher might find many traces of it yet lingering among us; so that Giant Caloric is not, perhaps, even yet quite dead, though certainly grown so crazy, and stiff in the joints, that he can now harm pilgrims no more.

So far as I know, no physicist of eminence re-asserted Melloni's principle till J. W. Draper, in 1872. Only sixteen years ago, or in 1872, it was almost universally believed that there were three different entities in the spectrum, represented by actinic, luminous, and thermal rays.

Draper remarks that a ray consists solely of ethereal vibrations whose lost *vis viva* may produce either heat or chemical change. He uses Descartes' analogy of the vibration of the air, and sound; but he makes no mention either of Descartes or of Melloni, and speaks of the principle as leading to a modification of views then 'universally' held. Since that time the theory has made such rapid progress, that, though some of the older men in England and on the European continent have not welcomed it, its adoption among all physicists of note may be said to be now universal, and a new era in our history begins with it. I mean by the recognition that there is one radiant energy which appears to us as 'actinic,' or 'luminous,' or 'thermal' radiation, according to the way we observe it. Heat and light, then, are not things in themselves, but whether different sensations in our own bodies, or different effects in other bodies, are merely effects of this mysterious thing we call radiant energy, without doing more in this than give a name to the ignorance which still hangs over the ultimate cause.

I am coming down dangerously near our own time, — dangerously for one who would be impartial in dealing with names of those living and with controversies still burning. In such a brief review of this century's study of radiant energy in other forms than light, it has been necessary to pass without mention the labors of such men as Pouillot and Becquerel in France, of Tyndall in England, and of Henry in America. It has been necessary to omit all mention of those who have advanced the knowledge of radiant energy as light, or I should have had to speak of labors so diverse as those of Fraunhofer, of Kirchoff, of Fresnel, of Stokes, of Lockyer, and many more. I have made no mention, in the instructive history of error, of many celebrated experimental researches; in particular of such a problem as the measurement of solar heat, great in importance, but apparently most simple in solution, yet which has now been carried on from generation to generation, each experimenter materially altering the result of his predecessor, and where our successors will probably correct our own results in time. I have not spoken of certain purely experimental investigations, like those of Dulong and Petit, which have involved immense and conscientious labor, and have apparently rightly earned the name of 'classic' from one generation, only to be recognized by the next as leading to wholly untrustworthy results, and leaving the work to be done again with new methods, guided by new principles.

In these instances, painstaking experiments have proved insufficient, less from want of skill in the investigator than from his ignorance of principles not established in time to enable him to interpret his experiments; but, if there were opportunity, it would be profitable to show how inexplicably sometimes error flourishes, grows, and maintains an apparently healthy appearance of truth, without having any root whatever. Perhaps I may cite one instance of this last from my own experience.

About fifteen years ago it was generally believed that the earth's atmosphere acted exactly the part of the glass in a hotbed, and that it kept the planet warm by exerting a specially powerful absorption on the infra-red rays.

I had been trained in the orthodox scientific church, of which I am happy to be still a member; but I had acquired perhaps an almost undue respect, not only for her dogmas, but for her least sayings. Accordingly, when my own experiments did not agree with the received statement, I concluded that my experiments must be wrong, and made them all over again, till spring, summer, autumn, and winter had passed, each season giving its own testimony; and this for successive years. The final conclusion was irresistible, that the universal statement of this alleged well-known fact (inexplicable as this might seem, in so simple a matter) was directly contradicted by experiment.

I had some natural curiosity to find how every one knew this to be a fact; but search only showed the same statement (that the earth's atmosphere absorbed dark heat like glass) repeated everywhere, with absolutely nowhere any observation or evidence whatever to prove it, but each writer quoting from an earlier one, till I was almost ready to believe it a dogma superior to reason, and resting on the well-known "*Quod semper, quod ubique, quod ab omnibus, creditum est.*"

Finally I appear to have found its source in the writings of Fourier, who, alluding to De Saussure's experiments (which showed that dark heat passed with comparative difficulty through glass), observes that if the earth's atmosphere were solid, it would act as the glass does. Fourier simply takes this (in which he is wholly wrong) for granted; but, as he is an authority on the theory of heat, his words are repeated without criticism, first by Poisson, then by others, and then in the text-books; and, the statement gaining weight by age, it comes to be believed absolutely, on no evidence whatever, for the next sixty years, that our atmosphere is a powerful absorber of precisely those rays which it most freely transmits.

The question of fact here, though important, is, I think, quite secondary to the query it raises as to the possible unsuspected influence of mere tradition in science, when we do not recognize it as such. Now, the Roman Church is doubtless quite logical in believing in tradition, if these are recommended to the faithful by an infallible guide; but are we, who have no infallible guide, quite safe in believing all we do, with our fond persuasion that in the scientific body mere tradition has no weight?

In even this brief sketch of the growth of the doctrine of radiant energy, we have perhaps seen that the history of the progress of this department of science is little else than a chapter in that larger history of human error which is still to be written and which, it is

safe to say, would include illustrations from other branches of science, as well as my own.

But — and here I ask pardon if I speak of myself — I have been led to review the labors of other searchers from this standpoint, because I had first learned, out of personal experience, that the most painstaking care was no guaranty of final accuracy; that to labor in the search for a truth with such endless pains as a man might bestow if his own salvation were in question did not necessarily bring the truth; and because, seeking to see whether this were the lot of other and greater men, I have found that it was, and that, though no one was altogether forsaken of the truth he sought (or, on the whole review of his life as a seeker, but might believe he had advanced her cause), yet there was no criterion by which it could be told at the time, whether, when after long waiting there came in view what seemed once more her beautiful face, it might not prove, after all, the mockery of error; and probably the appeal might be made to the experience of many investigators here with the question, "Is it not so?"

What then? Shall we admit that truth is only to be surely found under the guidance of an infallible church? If there be such a church, yes! Let us, however, remember that the church of science is not such a one, and be ready to face all the consequences of the knowledge that her truths are put forward by her as provisional only, and that her most faithful children are welcome to disprove them.

What then, again? Shall we say that the knowledge of truth is not advancing? It is advancing, and never so fast as to-day; but the steps of its advance are set on past errors, and the new truths become such stepping-stones in turn.

To say that what are truths to one generation are errors to the next, or that truth and error are but different aspects of the same thing to our poor human nature, may be to utter truisms; but truisms which one has verified for one's self out of a personal experience are apt to have a special value to the owner; and these lead, at any rate, to the natural question, "Where is, then, the evidence that we are advancing in reality, and not in our own imagination?"

There are many here who will no doubt heartily subscribe to the belief that there is no absolute criterion of truth for the individual, and admit that there is no positive guaranty that we, with this whole generation of scientific men, may not, like our predecessors, at times go the wrong way in a body, yet who believe as certainly that science as a whole, and this branch of it in particular, is advancing with hitherto unknown rapidity. In asking to be included in this number, let me add that to me the criterion of this advance is not in any ratiocination, not in any *a priori* truth, still less in the dictum of any authority, but in the undoubted observation that our doctrine of radiant energy is reaching out over nature in every direction, and proving itself by the fact that through its aid nature obeys us more and more; proving itself by such material evidence as is found in the practical applications of the doctrine, in the triumphs of modern photography, in the electric lights in our streets, and in a thousand ways which I will not pause to enumerate.

And here I might end, hoping that there may be some lessons for us in the history of what has been said. I will venture to ask the attention to one more, perhaps a minor one, but of a practical character. It is that in these days, when the advantage of organization is so fully recognized, when there is a well-founded hope that by co-operation among scientific men knowledge may be more rapidly increased, and when in the great scientific departments of government and elsewhere there is a tendency to the formation of the divisions of a sort of scientific army, — a tendency which may be most beneficially guided, — that at such a time we should yet remember, that, however rapidly science changes, human nature remains much the same; and (while we are uttering truisms) let us venture to say that there is a very great deal of this human nature even in the scientific man, whose best type is one nearly as unchanging as this nature itself, and one which cannot always advantageously be remodelled into a piece of even the most refined bureaucratic mechanism, but will work effectively only in certain ways, and not always at the word of command, nor always best in regiments, nor always best even under the best of discipline.

Finally, if I were asked what I thought were the next great steps to be taken in the study of radiant heat, I should feel unwilling to attempt to look more than a very little way in advance. Immediately before us, however, there is one great problem waiting solution. I mean the relation between temperature and radiation; for we know almost nothing of this, where knowledge would give new insight into almost every operation of nature, nearly every one of which is accompanied by the radiation or reception of heat, and would enable us to answer inquiries now put to physicists in vain by every department of science, from that of the naturalist as to the enigma of the brief radiation of the glow-worm, to that of the geologist who asks as to the number of million years required for the cooling of a world.

When, however, we begin to go beyond the points which seem, like this, to invite our very next steps in advance, we cannot venture to prophesy; for we can hardly discriminate among the unlimited possibilities which seem to open before a branch of knowledge which deals especially with that radiant energy which sustains, with our own being, that of all animated nature, of which humanity is but a part. If there be any students of nature here, who, feeling drawn to labor in this great field of hers, still doubt whether there is yet room, surely it may be said to them, "Yes, just as much room as ever, as much room as the whole earth offered to the first man;" for that field is simply unbounded. and every thing that has been done in the past is, I believe, as nothing to what remains before us.

The days of hardest trial and incessant bewildering error in which your elders have wrought seem over. You "in happier ages born," you of the younger and the coming race, who have a mind to enter in and possess it, may, as the last word here, be bidden to indulge in an equally unbounded hope.

A PLEA FOR LIGHT-WAVES.[1]

It is no doubt universally conceded that no era in the world's history has ever seen such immense and rapid strides in the practical applications of science as that in which it is our good fortune to live. Especially true is this of the wonderful achievements in the employment of electricity for almost every imaginable purpose. Hardly a problem suggests itself to the fertile mind of the inventor or investigator without suggesting or demanding the application of electricity to its solution.

If we except the exquisite results obtained in the manufacture and use of diffraction gratings, and the very important work accomplished by the bolometer (a purely electrical invention, by the way), it may well be questioned whether, within the last twenty years, there has been a single epoch-making discovery or invention either in theoretical optics or in its applications.

It is mainly with a view of attempting to interest brother physicists and investigators in this to me most beautiful and fascinating of all branches of physical inquiry, that I venture to present a limited number of problems, and I think promising fields for investigation, in light, together with some crude and tentative suggestions as to their solution.

The investigations here proposed all depend upon the phenomenon of interference of light-waves. In a certain sense all light-problems may be included in this category, but those to which I wish to draw your attention are specially those in which a series of light-waves has been divided into two pencils which re-unite in such a way as to produce the well-known phenomenon of interference fringes.

The apparatus by which this is effected is known by the inconvenient and somewhat inappropriate name of 'interferential refractometer.' As the instrument which I had the honor of describing to the section at the last meeting is simple in construction, and has already proved its value in several experiments already completed and in the preliminary work of others now under way, I may be permitted to recall the chief points of its construction and theory. A beam of light falls on the front surface of a plane parallel piece of optical glass at any angle, — usually forty-five degrees, — part being reflected, and part transmitted. The reflected portion is returned by a plane mirror, normal to its path, back through the inclined plate. The second or transmitted portion is also returned by a plane mirror, and is in part reflected by the inclined plate,

[1] Abstract of an address before the Section of Physics of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15-22, 1888, by Albert A. Michelson, vice-president of the section.

thus coinciding with the transmitted part of the first pencil; and the two pencils are thus brought to 'interfere.'[1] A little consideration will show that this arrangement is exactly equivalent to an air-film or plate between two plane surfaces. The interference phenomena are therefore the same as for such an air-plate.

If the virtual distance between the plane surfaces is small, white light may be employed, and we have then colored fringes like Newton's rings or the colors of a soap-film. If the distance exceeds a few wave-lengths, monochromatic light must be employed. We may confine our attention to the case of two parallel surfaces. Here it can readily be shown that the fringes are concentric circles, the common axis of the rings being the normal passing through the optical centre of the eye or telescope. Further, they are most distinct when the eye or the telescope is focused for parallel rays. In any other case we are troubled with the same perplexing changes of form and position of the fringes as already noted.

If, now, one of the mirrors have a motion normal to its surface, the interference rings expand or contract; and, by counting the fringes as they appear or disappear in the centre, we have a means of laying off any given distance in wave-lengths.

Should this work of connecting the arbitrary standard of length — the yard or the metre — with the unalterable length of a light-wave prove as feasible as it is hoped, a next step would be to furnish a standard of mass based upon the same unit.

Suppose a cube, ten centimetres on a side, with surfaces as nearly plane and parallel as possible. Next suppose a testing-instrument made of two parallel pieces of glass, whose inner surfaces are slightly farther apart than an edge of the cube. The parallelism and the distance of these surfaces can be verified to a twentieth of a wave. Now apply this testing-instrument to the three pairs of surfaces of the cube, and determine their form, parallelism, and distance to the same degree of accuracy. We have thus the means of measuring the volume of a cubic decimetre with an error less than one part in a million.

It does not seem extravagant to say that by some such plan as this we may obtain a standard kilogram which will be related to the standard of length with a degree of approximation far exceeding that of the present standard. The apparatus can also be used in the manufacture of plane surfaces, and in the measurement of co-efficients of expansion.

For all measurements of refraction and dispersion, — for solids and liquids as well as for gases, — and in the determination of the wave-length of standard lines, the accuracy of the measurement of absolute wave-lengths will depend on the accuracy with which the fixed distance can be compared with the standard metre; and this may be estimated as one part in two million.

The results of the remarkable work of Rowland do not claim a much greater degree of accuracy than one part in half a million for relative determinations; while the elaborate research of Bell on absolute wave-lengths claims but one in two hundred thousand.

It may possibly help to realize the very considerable superiority of this instrument over the grating — at any rate, for the class of work in question — if I recall to your attention the fact that by its means it has been possible to show that the red line of hydrogen is a very close double.

Closely connected with the preceding investigations is the study of the effect of the temperature, thickness, and density of the source on the composition of the radiations, as shown by the symmetrical or unsymmetrical broadening of the spectral lines, and the consequent shifting of their mean position. This question has quite recently been taken up by H. Ebert, and the results he has already obtained are very promising. Ebert has established two conclusions, which, if verified, are of the greatest importance: namely, first, that the chief factor in the broadening of the spectral lines is the increase in density of the radiating body; second, that the broadening, in all the cases examined, is unsymmetrical, causing a displacement of the line toward the red end of the spectrum. The importance of these conclusions, in their relation to the proper motions of the heavenly bodies and their physical condition, can hardly be overestimated. The value of results of this kind would, however, be much enhanced if it were possible to find a quantitative relation between the density of the radiating substance and the nature of its radiations. In the case of hydrogen enclosed in a vacuum tube this could readily be accomplished. It may, however, be objected that it would be difficult in this case to separate the effects of increased density from those due to the consequent increase in the temperature of the spark. The problem of the temperature of the electric discharge in rarefied gases is one which has not yet been solved. In fact, it may seriously be questioned whether in this case temperature has any thing to do with the accompanying phenomena of light; and it appears to me much more reasonable to suppose that the vibratory motion of the molecules is not produced by collisions at all, but rather by the sudden release of tension in the surrounding ether.

[1] A second plane parallel plate of the same thickness and inclination is placed (for compensation) in the path of the first pencil.

BOOK-REVIEWS.

The Philosophy of Kant. By JOHN WATSON. New York, Macmillan. 8°. $1.75.

THE present volume consists of a number of extracts from Kant's principal works, — 'The Critique of Pure Reason,' 'The Metaphysic of Morality,' 'The Critique of Practical Reason,' and 'The Critique of Judgment,' — and is intended for the use of teachers of philosophy. Undoubtedly the study of Kant is the best introduction into modern philosophy, and a powerful means of guarding students from falling into a shallow materialism or positivism. The extracts are well selected, and the difficult task of rendering Kant into intelligible English without altering the character of his style too much has been skilfully solved. The book is an enlarged edition of the author's 'Extracts from Kant's Writings,' which was originally printed for the use of his own students. Professor Watson says that he found by experience the results obtained by means of lectures on philosophy very unsatisfactory, as the students did not learn to think for themselves: therefore he adopted the plan of supplementing his lectures by the study of the writings of various philosophers. This is the same method which is so successfully followed at German universities in what are called 'seminaries.' The teacher who will take this course will find Watson's book very useful and convenient, as it contains the salient points of Kant's philosophy.

Latin Accidence and Exercises. By W. WELCH and C. G. DUFFIELD. London and New York, Macmillan. 24°. 40 cents.

THIS book is intended as an introduction to Macmillan's 'Elementary Classics.' The principles on which the authors' plan is based are a thorough and accurate mastery of the elements of the Latin language, and the putting into intelligent practice at once what has been learned, thus avoiding as much rote-work as possible. The examples have been taken largely from the 'Public Schools Latin Primer,' as the latter is most widely used in the higher forms. The authors do not deem it desirable that beginners should learn the conjunctive mood, which, for this reason, has been added in small type at the end of the 'Accidence.' The book is intended to be mastered in two terms.

Elementary School Atlas. By J. BARTHOLOMEW. London, Macmillan. 8°. 30 cents.

THE publication under review belongs to Macmillan's Geographical Series, edited by A. Geikie, who promoted the interests of teaching geography so well by his well-known essay on this subject. As might be expected, the atlas represents a great improvement upon the ordinary English elementary school-maps, the material which is embodied in the maps being carefully selected, and the abominable relief-plate printing being at last discarded, a clear lithograph taking its place. The atlas contains twenty-four maps or plates. The first shows a number of hemispheres: the northern and southern (land and water) and the European and South American. We would gladly miss the last, as it is intended only to show the central position of Europe. The second map is named 'Europe, illustrating Geographic Terms.' This map must be considered a failure, as it attempts the explanation of geographic terms, instead of by means of objects, by that of a highly and wrongly generalized map. The following plate, which illustrates the mapping of a landscape and the influence of reduction, ought

to precede the former, and we believe greater care in its technical execution would have been desirable. As the map is intended to explain the meaning of hill-shading, the view of the hills and the map ought to be clear, and it ought to be possible to compare them down to minute details. The fourth plate explains the system of meridians and parallels and the curvature of the earth's surface. The rest of the maps are well selected, and do not call for any special comment. The maps of the British Isles are very good. We think, however, that a hypsometric map like No. 11 is of no great value for educational purposes, as contour-lines, unaided by hill-shading, do not convey to the child a good idea of the physical features of a country. Considered as a whole, the atlas must be commended as a great improvement upon the ordinary school atlas.

NOTES AND NEWS.

THE United States Fish Commission is undertaking an extensive series of explorations of the fish fauna of the rivers of the Alleghany region. The work is in charge of Prof. D. S. Jordan, assisted by Prof. P. P. Jenkins, Prof. B. W. Evermann, and Mr. Barton A. Bean. The basins of the James, Kanawha, Roanoke, Holston, French Broad, Yadkin, and Catawba will be included in the work of the present summer. Similar explorations of the smaller lakes of Michigan are under direction of Mr. Charles H. Bollman.

— The fourth article in the Railway Series now appearing in *Scribner's Magazine* will be contributed to the September number by Gen. Horace Porter, who writes of 'Railway Passenger Travel.' —— 'The Record of a Human Soul' is the title of an anonymous little book to be published shortly by Longmans, Green, & Co. It is the honest account of the struggle of a sceptic, who ardently but unavailingly desired to believe, from the coming of the doubt until the hour when the doubter at last sees a light in heaven. It is introspective and subtle, but not morbid; its language is simple and direct; and the record is likely to be useful to not a few who have only the honest doubt in which there may be more faith than in half the creeds.

— The Canadian Institute, Toronto, Ont., is desirous of collecting, and incorporating in its Proceedings, reliable data respecting the political and social institutions, the customs, ceremonies, beliefs, pursuits, modes of living, habit, exchange, and the devolution of property and office, which obtain among the Indian peoples of the Dominion. It feels that this department of research has not been so fully cultivated in Canada as its importance demands, fears that the opportunity of gathering and carefully testing the necessary facts may with the advancing tide of European civilization soon pass away, and is of opinion that much light may be cast upon the genesis and growth of government as well as upon legal, sociological, and economic thought by an accurate study of the Indian tribes in their existing conditions and organizations. Contributions to the philology of the Indian tongues, and additions to their folk or myth lore, will be welcomed as heretofore. At the same time the institute begs leave, without desiring to contract the field of observation, to direct attention to the sociological matters.

— A new process for protecting iron against corrosion, now employed by a company at Port Chester, N.Y., is said to give satsfactory results. The company is now manufacturing sanitary soil-pipes treated by this method, which is described by Mr. H. Haupt as follows: "After the pipes have been lowered into the retorts by means of a traveller, the retorts are closed for about fifteen minutes until the contents are heated to the proper temperature. Steam from a boiler at sixty pounds pressure is then introduced into the superheater, which it traverses, and from which it escapes at the temperature of the iron, upon which it acts for about one hour. A measured quantity of some hydrocarbon is then admitted with a jet of steam, followed again by a fixing bath of superheated steam, which completes the process." Professor Gesner, the director of the works, says there is no pressure in the retort, and that there are no free explosive gases. The water-seals attached to the retorts show only slight oscillations, but not an inch of pressure; and when the covers are removed and air admitted there is no explosion, as there always is when free hydrogen or carbonic oxide is present. The absence of pressure and of explosive gases is a proof that all the operations have been so nicely regulated as regards material used, quantity, and time of application, that a perfect absorption and union of the carbon, oxygen, and hydrogen with the iron has been effected. The protection thus afforded to the iron is not a mere coating, like paint, but is said to be an actual conversion, to a greater or less depth, into a new material. When properly treated, this material does not seem to be detachable by pounding, bending, hammering, rolling, or heating. The pipes treated at Port Chester have been immersed in baths of dilute sulphuric acid and exposed to the salt air for weeks without change, while untreated pipes were quickly covered with red oxide, or with sulphate of iron.

LETTERS TO THE EDITOR.

Re-appearance of Song-Birds.

THE appearance of birds is always quite irregular, so far as numbers are concerned, with the possible exception of one or two varieties like the migratory thrush. We will find in any locality that the oriole is very plentiful for a few years, and then comparatively scarce for a few years. This cannot be mistaken by those on whose gardens he makes his inroads. The absence of gross-beaks and then their great abundance is equally marked. So of nearly all familiar birds. The cause is probably that they range over a large territory, and select different nesting-centres. It is well known that pigeons will cover the sky for two or three springs, moving to a camp in the farther north, and then for years not a pigeon be seen. I believe my catbirds alone have so taken to me that I can always count on their familiar forms and delicious notes.

The extraordinary abundance of song-birds is no doubt a simple coincidence or accidental agreement of action on the part of several species. In my own grounds I do not see any such unusual migration; for the reason, probably, that I have for many years so protected and fed them, that it is a paradise for birds. Yet it is true that several sorts of birds are on the increase here; owing, possibly, to finding their quarters disturbed elsewhere. The line of migration can be much more easily swerved than the ponderous and slow movements of animals. I think you may be sure that the abundance in some quarters is balanced by the deficit in other quarters. New influences constantly arise, affecting the peace and content of birds. I have all summer been fighting a band of pseudo-scientists; that is, boys who carry papers permitting them to shoot our birds to make collections for so-called scientific purposes. Before the law to protect our song-birds, no decent young man would prowl about near our residences to shoot the pets. But now they are 'scientists;' and we have no rights to be considered. They crack their guns under our very noses. But I have vowed to have a lawsuit with every budding Audubon that comes this way, and am at present ahead.

Now, here is a law that works not at the muzzle, but the but. Its effect is to scatter our birds in their favorite haunts. My grounds cover nine acres only, but several neighbors are in full accord; and there are full fifty acres of flowers, hedges, and fruit where the song-birds are wonderfully abundant. But how long would they remain with us if one after another fell victims the moment they flew outside our lines? Another year we should lament the absence of our birds, and somewhere else people would rejoice in their superabundance. E. P. POWELL.

Clinton, N.Y., Aug. 7.

The Physical Aspect of the Planet Mars.

THERE has been so much said of late, in the newspapers and elsewhere, in regard to the parallel canals of Mars, that perhaps a brief discussion of the facts observed in regard to them may be of interest. And first of all it may be remarked, that, of all the different methods of accounting for the appearances observed, perhaps the least probable is that they are water-canals.

Let us see what are the facts in the case. According to the observations of Schiaparelli (*Reale Accademia dei Lincei* 1881 and 1886) they lie almost entirely between 50° north and south latitude (that is, in the torrid and warmer portions of the temperate zones), and extend across the continent from the northern to the southern

ocean. They are in general two or three thousand miles in length, though sometimes much longer, by from perhaps thirty to one hundred and fifty miles in breadth. They are generally arranged in pairs two or three hundred miles apart, drawn on the arcs of great circles, and so exactly parallel that usually no deviation can be detected. They run in all directions, but there are about a dozen points which seem marked as special centres from which they radiate. Thus ten start from the Trivium Charontis as a centre, and eight from the Lacus Phœnicis. They cut up the continental surface of the planet so that there is no spot more than four hundred miles distant from one of these markings. They are usually so fine that no color can be assigned to them, and they can be merely spoken of as dark lines; but in a few instances where they broaden out, as in the Lyrtis Major (if this conspicuous marking can be considered one of them), they are decidedly darker than the oceans, and of a grayish or perhaps greenish tint.

Of a well-defined canal called by Schiaparelli, Hades, M. Perrotin (*Annales de l'Observ. de Nice*, c. 58) remarks, "Since our first observations, the canal *LN* has suffered a considerable change: we can distinguish it no longer save to a feeble extent on the side marked *N*. Though drawn on the map of M. Schiaparelli of 1882, this canal does not exist on that of 1879. Our observations, then, not only confirm the changes already stated, but they show further that these changes may be produced in a short period of time." Other evidences of change have since been observed. It is thought that a large portion of the red region known as Libya had changed to green, and afterwards in part back to red. But the latest evidence of change, according to M. Perrotin (*Comptes Rendus*, cvi. 1718, and cvii. 161), is the carrying of several of the so-called 'canals' across the northern ocean up to the polar ice-cap. If the observation is correct, it is clear that either the ocean is not an ocean, or the canals are not canals. If the observation were confirmed, I should be inclined to deny both propositions. Indeed, the northern ocean as represented by M. Perrotin at this point is but little more than an enlarged canal, while M. Schiaparelli does not indicate it at all upon his maps.

The latter has thought that many of these canals appear only for a short time, and then disappear again; and some of them he has only seen shortly after the passage of the vernal equinox on Mars, and thinks that there may be some relation between the two.

To every argument as to the inherent improbability of an hypothesis made with regard to a remote planet, we may be met by the statement that under different conditions these very things may happen, — a statement easily made, and hard to refute. The best we can do, however, is to reason by means of the laws which we have found to apply in the case of the earth. Certainly no such straight canals could be made here naturally, and, if they were made, they would soon be filled up again. If, on the other hand, the canals were artificial, what could be the use of making them so wide, why arrange them always in duplicate, and why fill certain of them up every year, later to be re-opened? Think of the labor involved in covering over, and then re-opening, a canal, say, sixty miles wide by three thousand miles long, and all in the space of a few weeks. Moreover, in the case of those which are sufficiently wide for us to see distinctly, why should the color be so much darker than that of the neighboring oceans?

Mr. R. A. Proctor has suggested (*Monthly Notices Roy. Ast. Soc.*, xlviii. 307) that the canals are the diffraction-images of rivers produced by mist which hangs over the river-beds. To this suggestion, however, some of the same objections apply as to the other.

M. Fizeau's suggestion (*Comptes Rendus*, cvi. 1759), that the stripes are cracks between huge masses of ice, presents some difficulty in accounting for the red color of the ice; and also, as was pointed out by M. Flammarion (*Comptes Rendus*, cvii. 19), since the temperature of Mars as indicated by the size of the polar spots, is, if any thing, higher than that of the earth, it is surprising that the ice does not melt.

Before going further let us see what is the probability that these supposed markings are really genuine. Several astronomers, — Dawes, Perly, Burton, and others — have independently constructed maps of Mars, or made observations from which such maps could be constructed; and it is found, on comparison, that a number of these stripes are common to several of the maps. It is therefore probable that these particular stripes are really there. M. Perrotin has confirmed the doubling of the stripes previously mapped by M. Schiaparelli: it is therefore quite possible that these are genuine also, although the observation is one of extreme difficulty, requiring the steadiest possible atmospheric conditions. But the statement that a change in the markings has been observed is one that must be received with extreme caution, and, although a most interesting one, must for this very reason be only accepted as proved, when confirmed by observations made with the most powerful telescopes at our disposal, and under the most favorable circumstances.

Starting out from the generally accepted fact that there are stripes upon the planet, we find there are five possible hypotheses to explain their existence. Three, that they are due to water in the vaporous, liquid, or solid condition, we have already noticed. Fourth, we may explain them by supposing them to depend on the color of the rock or soil, and that their shape depends on some peculiar geological formation. We have, to be sure, no such formations upon our globe; but we have something analogous, though on a somewhat smaller scale, upon the moon. There we find numerous long narrow streaks radiating from the crater Tycho, as also in a lesser degree from some of the other craters. The streaks are perfectly straight, of very light color, and in a few cases we find them arranged parallel to one another.

As to the color of Mars, it is probable that the earth would appear of the same color as seen from a distance, if deprived of its vegetation, owing to the red color of its soil in most parts of the world, particularly in the warmer regions.

If it can be shown, however, that at certain seasons the stripes on Mars really disappear, through some other cause than that of passing clouds or haze in its own atmosphere, then this hypothesis, like that of the water-canals, must fail.

The fifth and last of the possible explanations is that the stripes are due to differences in vegetation. Whether the stripes indicate vegetation, and the rest is a barren waste, or whether a large proportion of the vegetation of Mars is of a reddish color, as suggested by Lambert among others, and approaches in tint to our coleus and autumn leaves, is a matter of no consequence at present. If it can be shown that the stripes on Mars really change, this will be the hypothesis that we shall be forced to adopt, or, rather, we should say it is the only one left presenting no serious improbabilities.

Let us now review the already ascertained facts with regard to the planet. We are reasonably certain that the surface of Mars is composed of land and water; that it has snow at its poles, and therefore an atmosphere containing clouds. As the snow does not extend over the whole planet, but varies in extent at different times, and what are apparently clouds have been observed in other regions of its surface, it is probable that they likewise have rain. Their temperature cannot be very different from ours, judging by the extent of the snow at the poles, which is rather less in proportion than with us, and has in some instances been known to entirely disappear. Their days are but forty minutes longer than ours; and their seasons, owing to the inclination of the axis of Mars, are practically the same. The most marked difference between the two planets, of which we are certain, is, that, owing to the lesser attraction of Mars, bodies there would weigh but two-fifths as much as with us: a man, for instance, weighing one hundred and sixty pounds here, would weigh but sixty-four pounds upon Mars. All the conditions as far as we can determine, save that their sunlight is somewhat weaker, are as favorable to the growth of organic life there as here.

The spectroscope teaches us that the same elements are found throughout the universe: therefore, if we define vegetable life as consisting of organized structures absorbing carbonic acid and giving out oxygen, it will be seen that the admission that vegetable life exists upon Mars carries with it animal life also as a corollary, or vegetation would soon cease for lack of fresh air.

As Mars is a smaller planet than the earth, and more remote from the sun, it probably reached a suitable temperature to support organic life at an earlier date. The laws of evolution have therefore had sufficient time to develop reasonably highly organized animal as well as vegetable life.

This is as far as we are justified in carrying our hypothesis, unsupported by other facts; but now let us give rein to our fancy for

a moment, and suppose an observer on Mars were to examine the earth with successive increasingly powerful telescopes. The first artificial production that he would probably be able to see would be some of the great grain-fields of our Western States. These he would find of irregular shape, but bounded more or less by straight lines. They would appear of a greenish color, not very different from that of our oceans; and he would find them subject to great changes at certain seasons, sometimes perhaps entirely disappearing from sight, when of the same tint as the surrounding country. In fact, if an observer were placed on Mars, and furnished with one of our more powerful telescopes, he would see just about as much of our grain-fields as we do of their stripes, and the only noticeable difference between the two would lie in their shape. Indeed, assuming an artificial origin, it would be easy to frame hypotheses accounting for their form, dependent upon the peculiar conformation of the land surface of Mars, or for their radiating in several instances from particular points as centres.

But to return to our hypothesis, that the stripes are of vegetable origin. If it is correct, there is one test to which it must submit. If a change is noted in a given stripe, this change should be in general more or less progressive from the equator towards the poles, or *vice versa*. I say in general, because it is not probable that the same kind of vegetation would exist all the way from the equator to 50° north or south latitude, nor would it be the same in all stripes having the same latitude. Moreover, in the stripes running east and west, or in those situated near the equator, successive changes would not usually be noticeable. Stripes containing the same kind of vegetation should be similarly affected. Now, in the stripe known as Hades, previously referred to, this very phenomenon was observed. Hades runs in a direction nearly north and south, and extends from latitude 20° to 45° north. The observation in question was made about two and a half of our months after the passage of the northern solstice on Mars. It was therefore in the latter part of their summer when it was found that the southern portion of what had but a few weeks before been a well-defined stripe had completely disappeared.

As an illustration of the formation of a stripe running from the equator towards the pole, let us take the latest observations of M. Perrotin (*Comptes Rendus*, cvii. 161). According to these observations in the regions as far north as between latitudes 50° and 60°, the stripes did not appear this year until June 4, or four months after the summer solstice. Unfortunately, Mars is now getting so near the sun that it will be probably impracticable to determine the date of their disappearance, should they be found later to have vanished. WM. H. PICKERING.

Observatory, Cambridge, Mass., Aug. 9.

The Philippine Islands.

MR. WALLACE, in his great work, 'The Geographical Distribution of Animals,' divides the Oriental or Indian region of Mr. Sclater into four sub-regions, of which Java, Sumatra, Malacca, Borneo, and the Philippine Islands form one, which he calls the Indo-Malayan. In his discussion of the Indo-Malayan sub-region, Mr. Wallace recognizes several subdivisions of it, and treats of the Philippine group as one of the most important of these. Though acknowledging the existence of divisions of his sub-regions, he failed to give them technical names, as at that time uncalled for. The purpose of this paper is to show that the Philippines themselves are separated into several distinct zoölogical divisions; and it therefore seems necessary, for their study, to give technical names to the primary and secondary divisions of the already recognized sub-regions. The terms 'province' and 'sub-province' seem least objectionable, and will be used here; the Philippine Islands thus forming one of the provinces of the Indo-Malayan sub-region, and the divisions of the group itself sub-provinces.

The zoölogical province of the Philippines is co-extensive with the political division of the same name, with the exception, perhaps, of the islands of Sulu and Tawi Tawi, which lie between the Philippines and Borneo, but are claimed by the Spanish.

The sub-provinces proposed are, first, the northern Philippines, consisting of Luzon, Marinduque, and a number of other small islands about Luzon; second, Mindoro; third, the central Philippines, made up of the islands of Panay, Guimaras, Negros, Cebu, Bojol, and Masbate; fourth, the eastern Philippines, comprising the islands of Samar and Leite; fifth, the southern Philippines, embracing the great island of Mindanao, with Basilan; and, sixth, the western Philippines, consisting of the islands of Paragua or Palawan, and Balabac.

The geographical positions of these sub-provinces are fortunately such that these simple names show their relation to each other very closely, as may be seen by consulting a map of the archipelago.

Of these sub-provinces, the western Philippines, made up of Paragua and Balabac, and perhaps the Calamianes, is of most importance, its animal life being much more closely allied to that of Borneo than that of any other sub-province of the group. This is especially noticeable in its mammals, of which it possesses, in common with Borneo, the genera *Tragulus*, *Tupaia*, and *Manis*, which are apparently absent from the rest of the archipelago. Of Bornean genera of birds not found elsewhere in the group, *Jora*, *Criniger*, *Polyphetron*, *Tiga*, and *Batrachostomus* are examples The sub-province has evidently received a large part of its fauna from North Borneo, through Balabac, and at a comparatively recent date, and since its separation on the north from the rest of the Philippines, so that these genera have not flown over into Mindoro and Luzon. In addition to these apparently late arrivals from Borneo, the sub-province possesses a large number of peculiarly Philippine birds and mammals, which show that it is an integral part of the province.

The rest of the Philippines would seem to have received its Malayan fauna at another time and by the other way of Sulu and Mindanao. They possess the mammalian genera *Galeopithecus*, *Tarsius*, and *Cervus*, which are apparently wanting to the western sub-province, and the genera *Macacus*, *Sus*, *Viverra*, *Paradoxurus*, and *Sciurus* in common with it. Of birds, the genera *Loriculus*, *Cyclopsitta*, *Buceros*, and *Penelopides* are examples which are more or less generally distributed over the archipelago outside of the western sub-province.

The grounds for dividing the Philippines east of Paragua into sub-provinces are to quite an extent based upon species, and especially upon the existence in each of representative forms of the genera *Loriculus*, *Buceros*, *Penelopides*, *Brachiurus*, *Chrysocolaptes*, *Dicæum*, *Cinnyris*, etc. The hornbills form, perhaps, the most striking example of this distribution of representative species. Of the eleven species of hornbills collected in the islands, the western sub-province has one, the southern three, the central two, the eastern two, Mindoro one, and the northern two; and we have found no case of a single species occupying more than one sub-province, or of more than one species of a genus in a single sub-province. The genera *Chrysocolaptes* of woodpeckers is also noticeable, each sub-province possessing its own species, with the exception of Mindoro, which apparently lacks the genus altogether. The genus *Loriculus* of the parrots is of the same character.

Of other animals than birds, the genus *Sciurus* of mammals, and *Draco*, the flying lizards, seem to have representative species in each sub-province, and the land mollusca are probably distributed according to the same plan.

The above examples are a few that come to mind before a careful study of our collections has been made, and they do not by any means represent all the reasons for the conclusions arrived at. These are the result, rather, of the observation of five careful men who have been collecting and studying in the Philippines during the last year. During this time we have visited and collected in fifteen of the islands of the group, and these the largest and most important. I am satisfied that the study of our collections, with the aid of the libraries and collections at home, will only strengthen the conclusions of this paper. It may prove necessary to make the so-called western sub-province of more importance in the arrangement, but the non-existence in nature of exactly equivalent divisions of any kind is well recognized. It is hoped that our work may aid in untangling some of those puzzles in which students of Philippine zoölogy have found themselves involved, and that it will also add considerably to the sum of knowledge concerning this as yet imperfectly known corner of the earth. J. B. STEERE.

Manila, July 2.

Publications received at Editor's Office, Aug' 13-18.

ALDEN'S Manifold Cyclopedia of Knowledge and Language. Vol. VI. Bravo to Calville. New York, J. B. Alden. 12°. 50 cents.

—— The same. Vol. VII. Calvin to Cevennes. New York, J. B. Alden. 12°. 50 cents.

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BOSANQUET, B. Logic; or, The Morphology of knowledge. Vols. I. and II. Oxford, Clarendon Pr. 638 p. 8°. New York, Macmillan, $5.25.

PENNSYLVANIA Geological Survey. Atlas Northern Anthracite Field. Part II. Harrisburg, State. 10 pl. 8°.

—— Annual Report of, 1886. Part IV. Paint, Iron Ore, Limestone, Serpentine. With atlas. Harrisburg, State. 306 p. 8°.

STEEN, A. S. Beobachtungs-Ergebnisse der norwegischen Polarstation Bossekop in alten. Theil. II. Erdmagnetismus. Nordlicht. Christiania, Grondahl & Son. 4°.

WATSON, J. The Philosophy of Kant, as contained in Extracts from his own Writings. New York, Macmillan. 356 p. 12°. $1.75.

WELCH, W., and DUFFIELD, C. G. Latin Accidence and exercises. London and New York, Macmillan. 78 p. 24°. 40 cents.

WILLISTON, S. W. Synopsis of the Families and Genera of North American Diptera. New Haven, J. T. Hathaway. 84 p. 12°. $1.

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SCIENCE

FRIDAY, AUGUST 24, 1888.

ASIDE FROM ITS ECONOMIC IMPORTANCE, which cannot be exaggerated, Major Powell's letter to the New Orleans Chamber of Commerce, printed in full on another page of *Science*, on the relief of the alluvial lands of the lower Mississippi from destructive floods, contains the first formal announcement of a new law in the hydraulics of rivers. It is set forth in these words: "The cutting power of a stream increases rapidly with the increase of sedimentary load." This principle was briefly stated by Major Powell in a short oral address before the American Association for the Advancement of Science, about ten years ago, and he has indirectly referred to it two or three times since, in a word or two, in his writings; but this is the first specific statement of it that he has made, and this he considers as barely more than indicating the line of discussion which he has long intended to pursue in a volume that he proposes to write upon the subject. But the principle is stated in this paper with sufficient detail and illustration to arrest the attention of physicists and engineers, and to give rise to an interesting discussion. This Major Powell invites, and the columns of *Science* will be gladly placed at the disposal of any of its readers who may desire to express an opinion, either favorable or unfavorable, to the new theory.

IT IS CHEERING to note that another step in advance in the line of statistical science has recently been taken. A year ago Colonel Wright made a marked impression by demanding that statistics be given a place in the collegiate curriculum. Now the American Statistical Association, which possesses a quiet history of forty years in its records, announces a publication, to appear at regular intervals, devoted to the interests of statistics. This association in the past has been practically but a local society of Boston, formerly fostered by the late Dr. Jarvis, so eminent in the field of vital statistics, and at the present time officered by General Walker (its president), and Mr. Edward Atkinson (its corresponding secretary). The association welcomes to membership all who are interested in statistical work, and hopes in the future to be able to issue a representative journal which may compare favorably with similar European publications. There is no reason why this cannot be done. In no country is the utility and application of statistics more generally recognized than in the United States: it only remains to create an intelligent interest in their proper collection and tabulation. The venture of the publication of a work upon technical statistics, like that of Mr. Pidgin, entitled 'Practical Statistics,' furnishes added testimony to the development in progress. We also understand that during the past year a course upon statistics has been introduced at the University of Michigan, under the direction of Prof. Henry C. Adams.

PREVENTION OF FLOODS IN THE LOWER MISSISSIPPI.

POPULAR interest in the proposed investigation by the United States Geological Survey, of the problem of storing the waters of the upper Missouri and other Far Western rivers in great reservoirs, and the reclamation by irrigation of vast areas of what are now waste lands, spreads as some of the incidental effects of those great works, should they be undertaken, are beginning to be understood. An illustration of this is a letter from the New Orleans Chamber of Commerce to Director Powell, asking him what the effect of the proposed reservoir system will be upon the commercial and agricultural interests of the lower Mississippi. In reply he has prepared and forwarded the following paper, which, aside from the economic possibilities it suggests, is an important contribution to the scientific discussion of the hydraulics of the Mississippi River. The paper is given in full.

The control of the lower Mississippi is a problem of great magnitude, and the conditions are of great complexity. The end to be attained is to give the channel stability of position, and sufficient depth and breadth to make it a perfect conduit, capable of transporting to the sea all the water sent down by floods, thus relieving the adjacent country from danger of overflow. To accomplish this end it is necessary (1) to prevent the choking of the channel by excessive sedimentation, and this is the most important remedy; and (2) to diminish the volume of the floods by the storage of water above at flood-time; this is an accessory but important remedy. The relief of the river from excess of sediment, and the storage of the superabundant water at flood-time, may be accomplished by the same method, and its accomplishment may also involve the irrigation of the arid lands on the eastern slope of the Rocky Mountains. All this must be set forth more fully.

The Mississippi and its tributaries receive and transport to the sea the drainage of about 1,250,000 square miles. To obtain an idea of the work done by this river system, some facts must be understood.

The volume of drainage passing New Orleans is, on the average, 675,000 cubic feet per second, or about 150 cubic miles per year. The average contributions in cubic feet per second of the principal tributaries in the system are, in round numbers, as follows:—

	Cubic Feet per Second.
Upper Mississippi	100,000
Missouri	120,000
Ohio	160,000
St. Francis	3[illegible],000
Arkansas and White	60,000
Yazoo	40,000
Red	6[illegible],000

A portion of the grand total poured into the valley below Cairo escapes through the Atchafalaya and other bayous even at average river stages, put probably not less than eighty per cent of that total finds its route to the sea at present by way of the Crescent City. During flood-stage the outflow by the same route rises to about one million cubic feet per second; but the rate of inflow into the valley may at such stages exceed twice the carrying capacity of the main branch of the Atchafalaya. Of the three main tributaries, the discharge has been found to rise during floods in the upper Mississippi and Missouri to three times, and in the Ohio to seven times, the average amount.

Such, in brief, are the most apparent facts as to the volume of drainage discharge. But these do not disclose two other facts which are of prime importance in the engineering problems presented by the Mississippi; viz., that this river is a river of mud from the Missouri to the Gulf, and that the Missouri is the principal source of mud-supply.

Much attention has been given recently by the Mississippi River and the Missouri River Commissions to observations of the amount of sediment in transport at various points along the Mississippi and Missouri. These observations show that near New Orleans the amount of sediment in transport varies from $\frac{1}{500}$ to $\frac{1}{1000}$ part of the total volume discharged, and averages about $\frac{1}{3000}$ part of that volume. Above the mouth of the Missouri the Mississippi carries much less sediment, the range being from $\frac{1}{500}$ to $\frac{1}{100000}$, with an average of $\frac{1}{1500}$ part of the volume. The Missouri, on the other hand, is always heavily loaded with sediment. Just above its point of confluence with the Mississippi the amount in transport varies

from $\frac{1}{200}$ to $\frac{1}{5000}$, with an average of $\frac{1}{700}$ part of the volume. Direct measurements on the turbidity of the Ohio do not appear to have been made; but observations on the Mississippi at Columbus, Ky., indicate that the Ohio, like the upper Mississippi, is comparatively free from sediment. The observations just mentioned show, in fact, that the turbidity of the Mississippi at Columbus, Ky., follows closely the turbidity of the Missouri at St. Charles; and it is estimated that more than eighty per cent of the sediment in the Mississippi at Columbus comes from the Missouri. The amount of sediment carried into the Gulf is less certain than the amount poured into the valley at Cairo, since the load brought in by the minor tributaries and the load carried off by the Atchafalaya are unknown. But under any reasonable supposition concerning the carrying capacity of the Atchafalaya, it appears that from $\frac{1}{2000}$ to $\frac{1}{3000}$ of the total discharge into the Gulf is mud; and, on comparing these figures with the corresponding values for the Missouri, it appears that this tributary furnishes from forty to sixty per cent of that mud.

It is seen, then, that the Mississippi from its junction with the Missouri bears onward to the Gulf a load which increases with the accession of every affluent. But the bald figures cited do not readily give an adequate impression of this important fact. Let it be stated, then, in another form, and in numbers more readily grasped. It will suffice to give the output of the Missouri, which has been carefully measured.

The average discharge of sediment from the Missouri is, in round numbers, 170 cubic feet per second, or 500,000 cubic yards per day, or 180,000,000 cubic yards per year. At flood-stage the discharge of sediment has been observed to be as great as 4,000,000 cubic yards per day. The latter amount is equivalent in volume to a levee 100 square yards in cross-section and 23 miles long, and the average annual output would suffice to build more than 1,000 miles of such levee. The volume poured into the Gulf is about twice this output.

Now, what is the effect of this sedimentary load on the course and character of the river from St. Louis to the Gulf? Observations on river-systems, and studies of river-action in general, lead to the recognition of this principle; namely, that the cutting power of a stream increases rapidly with an increase of sedimentary load. A stream with a clear supply cleans and maintains a fixed channel. Gorge a stream with sediment, and its equilibrium becomes unstable. It cuts away its banks here and piles up sediment there, so that the position of the channel is ephemeral; and during flood-stage the burden of water is unloaded upon the adjacent lands. That this may be clearly understood, let it be stated in another way.

When a river receives from a tributary a disproportionately great load of sediment, such sediment is soon deposited, and the channel is thereby choked. This choking is of a peculiar nature; for the sediment is not deposited evenly along the bottom of the channel, but is thrown down in the quiet waters, that is, it is deposited irregularly along the course of the stream, now on one side and now on the other. These irregular deposits turn the current of the stream and throw it against the banks, now on one side and now on the other. By this agency the banks are cut, and the waters of the river are again loaded with sediment, which is again thrown down, and again the stream is turned against its banks and again loaded, and again deposits are made. It is thus that the original overload of sediment is made the occasion for a series of operations, each one of which serves to choke the channel in such a manner that the floods are thrown out upon the adjacent land. As long as a stream running through a flood-plain is overloaded with sediment, just so long will it choke its channel, and just so long will it change the position of its channel, and just so long will it inundate the adjacent lands of the flood-plain at the time of flood.

The action of the Mississippi exemplifies this principle on a grand scale. To appreciate its importance, it is only necessary to consider the tortuous and constantly shifting course of the reach from the Ohio to the Atchafalaya, and the menacing dangers to deep-water navigation along the lower reach. The upper of these reaches is the region of greatest lateral corrasion or bank-cutting. It is here that the abrading materials of the principal tributaries are brought together; and, impelled by the force of an appropriate declivity, they here do their heaviest work. Here they are ground and reground, and dug up and redeposited. Much of the coarser sediment is left, especially during floods, to add to the geological growth of the region, while vast quantities pass on to the sea. The lower reach is at present one of greater stability. The absence of large tributaries, and the escape of floods into the upper basins, give it a steadier flow; and the mud with which it is loaded is more finely comminuted, and hence more easily transported to the Gulf. But the disturbing element is present, and liable at any flood-stage to work disastrous effects.

It must be clearly understood that the diminution of the volume of water in the lower Mississippi is not the prime end to be sought. The prime end to be sought, in order to prevent destructive floods, is to prevent the choking of the channel. The storing of flood-waters on the Ohio and on the upper Mississippi would at first relieve the lower flood-plain; but, on the other hand, the choking of the lower channel would afterward progress at an increased rate, and ultimately the storage of such waters would augment the danger and destruction. But the storage of the waters of the Missouri, and other tributaries that are surcharged with sediment, so as to deposit this sediment on the plains, would permit the purer waters to open a sufficient channel for themselves. and the Mississippi plain would thus be protected. The real problem is to relieve the river of its excess of sediment, and thus prevent lateral cutting and promote vertical scouring, and thus provide adequate channel-room for the greatest floods.

Of the three rivers that contribute the principal volume of flood-waters to the lower Mississippi, the Ohio supplies the largest amount, and is subject to the greatest variation; but when the flood comes, a thousand cubic feet per second extracted from one river diminishes the flood exactly the same as if taken from another.

If the Missouri River be relieved of the enormous quantities of mud supplied to it by the bad-land and sand-plain rivers, it will cease to cut its own banks, and will discharge its waters into the Mississippi, destitute of the sediment coming from these tributaries, and also destitute of the sediment derived from lateral cutting. When the waters of the Missouri are thus delivered to the Mississippi in a comparatively pure condition, they will cease to choke the Mississippi; and the clearer waters of the combined Missouri, upper Mississippi, and Ohio, flowing in one volume as the lower Mississippi, will be able to keep its channel unobstructed.

It will now be readily understood why the storage of the head waters of the Missouri and other western tributaries, and their diversion for the purposes of irrigation, will result beneficially to the agricultural interests and to the navigation of the lower Mississippi. The advantages to navigation and the immunity from floods made possible by storage reservoirs alone are well known; but there should be added to these benefits that which comes from depriving the stream of its chief instrument of corrasion, namely, sediment. Such reservoirs should be constructed along the tributaries of the Missouri, which, as we have seen, is the main source of the sediment-supply of the Mississippi system. Fed by the drainage of the steep slopes of the Rocky Mountains and the bad-lands and the sand-fields of the Great Plains, the waters of the Missouri come loaded with the materials which go on cutting and grinding with constantly increasing energy in their journey to the sea, choking the channel and cutting away the land. Imprison these waters in settling basins, divert them to the purposes of irrigation, and they are robbed of their destructive agency.

It is not maintained that such storage and irrigation works will entirely supplant other resources of the engineering art (revetments, wing-dams, jetties, etc., will still have their uses), but the principal difficulties in the way of the successful application of these resources will disappear with the establishment of the work proposed; and, until such works are constructed, the secondary agencies for the control of the river will be useless.

The waters which are precipitated on the Rocky Mountains, and which roll over the sands and bad-lands of the Plains, are those which directly and indirectly load the Mississippi with its superabundant sediment. These waters are all needed in the arid lands through which they flow, that such lands may be redeemed by irrigation to agricultural purposes. The sediment which they carry can be poured on desert wastes, and render them fertile; and the

channel of the Mississippi from Cairo to its mouth may be relieved of this destroying agency; and the flood-plain valley of the Mississippi itself can be protected from the destroyer; and the channel of the river may be made far more stable, and its cross-section far more uniform, and sufficiently ample to carry the waters of the greatest floods, — all by spreading the rivers of the West over the upper valleys of the Rocky Mountains and over the arid plains. It is thus, and thus only, that the lower Mississippi can be protected; and it is thus, and only thus, that the arid lands can be redeemed. The two problems are inseparably joined. Irrigate the deserts and make them gardens and wheat-fields, and by the same process you protect the flood-plain of the Mississippi and make corn-fields and cotton-fields.

THE THIRTY-SEVENTH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE thirty-seventh meeting of the American Association for the Advancement of Science, which was held the past week at Cleveland, O., was not as well attended as the meetings of this great association usually are; but it was nevertheless as successful, and as useful for science, as those of the preceding years. The meeting opened on Wednesday, Aug. 15, with 81 members in attendance. Before the close of the day the number swelled to 258, on Thursday to 303, and on the following day many citizens of Cleveland joined it. A very remarkable feature of this meeting was that only a few citizens of Cleveland numbered on the lists of the first three days, although they showed their interest in the proceedings of the association in other ways, — first of all, by their hospitality, which was very much appreciated by their guests; by attending the evening sessions; and by very full and well-edited reports in the local newspapers. The meeting of the association this year, though not showing as great a number of members attending as last year, and consequently a smaller increase in membership, is remarkable for the great number of eminent scientists taking part in it. The scientific departments of Washington were well represented; and the New England States, as well as all the States from New York to Arkansas and Minnesota, sent most of their prominent scientists.

The meetings were held in the Central High School. In order to bring about closer social meetings between members of the association, brief general sessions were held every morning, and the members met in the hall where these sessions were held. Social intercourse was also promoted by a very enjoyable arrangement of the local committee, who served every day a lunch to the members of the association in the High School, thus inducing them to spend the interval between the morning and afternoon sessions at the school. As the promotion of social intercourse during these meetings is of equal importance with the papers read and the discussions in the various sections, these arrangements are well worth being recorded, and greatly contributed to the success of the meeting.

The programme was similar in character to those of former meetings of the association. The meeting was called to order on Wednesday, Aug. 15, by the retiring president, Prof. S. P. Langley, who resigned the chair to the new president, Major J. W. Powell. A hearty welcome was extended to the members of the association by representatives of the city of Cleveland and of the local committee, to which the president replied, and the sections were organized in their respective halls. At the general meeting the permanent secretary reported on the financial state of the association, from which we were glad to learn that the property of the association has increased materially, and that the research fund, which consists of the contributions of life-members, amounts to more than $4,400.

In the afternoon the vice-presidents of the sections delivered their addresses. In the evening the retiring president, Professor Langley, addressed the association on the subject of the history of the theory of radiant heat, in which address he forcibly brought home the truth that the progress of science is not always on the right line, but that it is only found after many futile attempts, and frequently after long following the wrong track. Thus he proved the importance of the study of the history of science. The address was printed in the last number of *Science*.

On Tuesday a number of geologists had held a meeting, and appointed a committee to bring in a constitution and by-laws for an American geological society. The committee consisted of Prof. A. Winchell of Ann Arbor, John S. Stevenson of New York, C. H. Hitchcock of New Hampshire, Edward Orton of Ohio, and John R. Proctor of Kentucky. On Wednesday, after the organization of the section, a meeting was held, which was well attended, and it was resolved that the society should be formed on the basis proposed by the committee.

On Thursday the sections began their regular sessions, of which a report will be given next week. The important feature of this day was a lecture delivered by President G. Stanley Hall of Clark University of Worcester, Mass. It was the first time that the new psychology had been given a place on the programme of the association; and nobody was better qualified to introduce this important subject in the association than Professor Hall, who was the first to cultivate this branch of science in America. It is to be hoped that this study, now that attention has been called to it, will continue to form part of the proceedings of the association.

Professor Hall gave a brief review of the scope of experimental psychology. He dwelt on the researches made in the study of psychologic physiology, and on the functions of brain and nerves; he mentioned the methods of psychophysic inquiries, and the important bearing of ethnological studies upon psychologic questions. He concluded his sketch, which was listened to with the greatest attention, with a reference to the study of hypnotism, which is one of the most promising fields of psychic research.

On Friday evening Major J. W. Powell delivered a lecture on 'Competition as a Factor in Human Progress.' In his forcible and graphic way, the lecturer gave the results of his study of the history of civilization and of human progress, which is based on his views as an ethnologist. He compared the evolution of society to that of animals and plants, and showed that the term 'survival of the fittest' does not apply in the same way in sociology and in biology.

Saturday was devoted to an excursion to Put-in-Bay, one of the islands in the western extremity of Lake Erie. The day was very pleasantly spent, the weather being fine. The remarkable glacial striæ of Kelley's Island were visited on this trip.

SCIENTIFIC NEWS IN WASHINGTON.

The Latest Public-School Statistics: Some Interesting Figures and Comparisons of School Population, Enrolment, and Attendance. — Plastering Wines in France: a Searching Investigation by the French Academy of Medicine: Adverse Report.

School Attendance in the United States.

THE annual report of the United States commissioner of education for 1886–87 is now going through the press at the Government Printing-Office, but copies of the volume will not probably be ready for distribution until next winter. The report of Commissioner Dawson, besides giving the usual statements of the organization and administration of his office, is supplemented with an explanation of his plan to publish in a series of monographs a history of education in the United States, and an account of his visit to Alaska, with suggestions as to the education of the people of that far-off Territory.

The commissioner's statement is followed by twenty-two chapters, which, in addition to presenting the usual statistics, digests of State school reports, etc., treat of the training of teachers, kindergartens, secondary instruction, superior instruction, professional instruction, manual and industrial training, education of special classes, libraries in the United States, and many other important educational subjects, and a chapter of papers on important educational topics by men of recognized authority on the subjects upon which they write.

In addition to the usual statistical tables accompanying the report, Commissioner Dawson has directed the preparation of several new and quite important ones, and the addition of new columns to some of the old ones. This work has been done by Mr. F. E.

Upton, of the Bureau of Education, who has added some notes of explanation. These treat of many important and interesting subjects, and will be referred to again in future numbers of *Science*. Some of the more striking facts in regard to school-census population and attendance are given here.

"Although the school-census populations," says Mr. Upton in one of his notes, "may not be compared with each other, nor aggregated, on account of their heterogeneity, the percentage of increase of these populations may, if we assume that the population between any two limits of age in any State increases in the same ratio as that between any other two limits (i.e., that the proportion of the population of any given age remains constant in each State), — an assumption that may be made as regards the increase of a few years within very narrow limits of error. It is on this assumption that the percentage of increase or decrease of school-census population has been aggregated by geographical divisions."

The geographical divisions are as follows: North Atlantic division, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania; South Atlantic division, Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida; south central division, Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Arkansas; north central division, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, Dakota, Nebraska, Kansas; western division, Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Washington, Oregon, California.

"The largest percentage [in school-census population] is found, as might be expected, in the western division, which contains the newer States and Territories, and where a small absolute increase sometimes causes a large relative one. In the five States and Territories of that division that furnish the necessary data, the average increase per cent of the school-census population is found to be 5.68, which would cause it to double in about twelve and a half years. The next largest rate of growth of school-census population is found in the South. The percentage of increase in the South Atlantic division (based on two States only) is 3.21.

"The total public-school enrolment of the United States, as made up from the latest data received and supplemented by estimates in two cases (Arkansas and Montana), is 11,805,660. The yearly increase for the United States cannot be accurately determined, as ten States and Territories do not furnish the necessary data. Assuming, however, that the States and Territories so lacking have made the same progress as the others in the same divisions, the yearly increase would be 305,772, or at the rate of 2.66 per cent per annum. In only five States (New Hampshire, Vermont, South Carolina, Ohio, and Nevada) and one Territory (Arizona) has the enrolment decreased. The largest relative decrease (5.37 per cent) is found in New Hampshire. Dakota furnishes the largest per cent of increase (11.70 per cent), followed by Indiana with 9.20 per cent. The large development of the school-registration of Indiana is a notable circumstance, when compared with the nearly stationary condition of the contiguous States, Ohio and Illinois.

"In the proportion of children enrolled in the public schools, the North Central States are far in the lead, having 121 pupils in the public schools for every 100 children six to fourteen years of age. That this should be a matter of congratulation, considering the relatively low density of population of those States, has already been noted.

"Notwithstanding the tremendous strides that have been made in the development of the school systems of the Southern States during the past ten years, they are still far behind the Northern States in regard to the proportion of children enrolled in the public schools. In the South Atlantic States only 89, and in the South Central States only 79, children out of every 100, six to fourteen years of age, are enrolled as pupils in the public schools. This results in a great degree from the excessive proportion of children to grown persons met with in the Southern States: for, if we compare the proportion of total population enrolled, the disparity which appears to the prejudice of the Southern States almost disappears, and in one case is quite reversed; i.e., the proportion of total population enrolled is actually greater in the two southern divisions (being 19.06 and 17.49 in the cases referred to) than it is in the western division (16.86). No account is taken here of the duration of attendance at school, but only of the circumstance that the pupils were on the school registers. If the element of time is taken into consideration, the South appears much more at disadvantage. The great advantage which the Northern States possess is the much larger number of tax-payers in proportion to the number of children to be educated. Even if the relative wealth of the North and the South were equal, which is far from being the case, each tax-payer of the former section would have a far less burden to bear in the work of getting all the schoolable children within the schools.

"According to the most recent returns, the number of pupils daily attending the public schools of the United States while they are in session, is, on an average, 7,571,416. As in the case of enrolment, it is not possible to determine the exact yearly increase; but a very fair approximation places it at 218,500, or at the yearly rate of 2.89 per cent. The greatest increase in average attendance is observable in the South. In both of the southern divisions it is not only remarkably large, but it is to be noted that it exceeds the increase of enrolment: in other words, not only more pupils are going to school there, but the attendance of those who do go is more regular. This is an evidence of increased appreciation of public schools not to be overlooked. Florida shows the greatest growth of average attendance; viz., 13.94 per cent. In the District of Columbia, Virginia, and Georgia, the growth is also exceedingly noteworthy. Indiana stands in the same relation to the States on her east and west borders as in the case of enrolment. The average attendance has decreased in six States, so far as reported, — New Hampshire, Vermont, Rhode Island, Connecticut, New York, and South Carolina. The greatest decrease (3.64 per cent) took place in New Hampshire." This may be partially explained by the fact that the private-school enrolment has increased 3.57 per cent in Vermont, 5.13 in Connecticut, and 4.12 in New York. These figures may be considered as establishing conclusively the fact that the private schools are gaining on the public schools in the States mentioned, and the presumption that they are so doing in the neighboring States.

"The rate of increase of average attendance for the United States (2.89 per cent) exceeds slightly the rate of increase of enrolment (2.66 per cent) as estimated. This indicates a greater regularity of attendance for the country at large. The average attendance for the United States is 64.13: that is, for every 100 pupils enrolled during the school-year, 64 have attended daily, on an average, during the sessions of the schools; or, looking at the matter in another light, each pupil enrolled was present, on an average, 64 out of every 100 days his school was in session.

"Regularity of attendance is greatest in the western division (66.51), and least in the South Atlantic division (62.79), but it is nearly uniform in the different sections of the country; more so, perhaps, than any other single item which admits of statistical record. When the individual States are considered, a greater inequality is observed. In Maine and Arizona the regularity of attendance is 82.79 and 84.26 respectively, while in Minnesota it drops to 49.17. It is possible, however, as in other instances, that this inequality may be due in some measure to inaccuracy or incompleteness in the school reports, or a lack of uniformity in the methods used. This regularity of attendance is far from being as high as is to be desired. Compulsory attendance laws do not seem to affect it to any appreciable extent, as it is somewhat higher in the South Central States, where there are no compulsory laws, than in the North Central States. It will probably depend for improvement upon a growing appreciation of the benefits of a public-school education.

"Such as it is now, however, it is far in advance of any former period, and the progress it has made in the last semi-decade is especially noteworthy. The tendency suggested by the figures is unmistakable. They show conclusively the steady growth of a sentiment in favor of popular education, — a growth not confined to any one part of the country, but extending throughout its length and breadth. This remark will be seen to possess greater force when it is considered that there has been an increase in the proportion of children enrolled as pupils, as well as an increase in the proportion of the number enrolled who attend regularly."

The Plastering of Wine.

The latest of the United States consular reports published by the State department contains a report by Walter T. Griffin, commercial agent, upon the plastering of wines. Since the great reduction in the amount of wines manufactured in the Bordeaux and Burgundy districts, the inferior wines of the central departments of France are being substituted for them, and recourse is had to chemical addition for the purpose of increasing their market-value. So important is this matter considered, that the question whether the plastering of wine is injurious to public health or not is now being discussed by the Academy of Medicine at Paris.

The plastering of wine consists in adding sulphate of lime after the first fermentation, or while the wine is in the vat; it is also mixed with the grape-must. The general rule is to put in five hundred grams of the plaster to the hectolitre of wine, but the greater number of wine-makers throw in the lime without weighing. The advantages said to be gained by the use of sulphate of lime are, that fermentation is greatly increased, is more rapid and complete, the color is brighter and more permanent, and the wine will keep for a much longer period. The objections are, that the addition of sulphate of lime causes chemical changes that render the wine injurious to health. The reasons given are these: wine, in its normal condition, contains a certain amount of bi-tartrate of potash, which, when brought in contact with sulphate of lime, forms an acid sulphate of potash, and there is precipitated an insoluble bi-tartrate of lime, varying according to its degree of alcohol, the wine dissolving a portion of the sulphate of lime.

Natural wine contains, at a maximum, about half a gram of sulphate of potash per litre. This quantity is increased from five to ten fold by the action of the lime, and at the same time the proportion of the bi-tartrate of potash diminishes to such a degree that it may be said that the lime substitutes for this salt the acid sulphate of potash. Finally, in wine treated with lime, sulphuric acid is found in a free state, also the sulphate of magnesia. There are three parties to the contest, — the proprietors and wine-merchants, who increase their profits by the plastering of the wine; the hygienists, who have always insisted upon the injurious effects of the practice; and the chemists, who have never given a final decision. The present discussion in the Academy of Medicine is the outgrowth of advice asked by the government of it and of the hygienic committees. A report of the progress thus far made in its inquiry by the academy has been made by M. Marty, who was designated to prepare it.

The paper is largely historical, and only a brief notice of that part of it will be made here. The hygienic committee, in 1856, reported in favor of plastering. The following year numerous evil consequences resulted from the plastered wines at St. Affrique, in the department of Aveyron. The doctors state that those who drank of this wine had an unquenchable thirst (cephalalgy) and an insupportable dryness of the throat. These are only the superficial symptoms and lesions that plastered wines produce in the organism. About the same time the Chamber of Commerce employed a committee of chemists to inquire into the matter, and they sustained the opinion given by the hygienic committee. In 1858 M. Poggiale, after new researches, found in the ashes of plastered wines an almost entire absence of bi-tartrate of potash, and an entirely abnormal proportion of sulphate of potash. He concluded that the practice of plastering had better be abandoned, as he considered it injurious to health. The *conseils generaux* entered into the lists after the decision given by the court at Roanne, which was against plastered wine. They demanded a new scientific inquiry. For a second time the hygienic committee, in spite of a spirited protestation from Michel Levy, declared in favor of plastering. M. Buignet and M. Bussy re-analyzed the plastered wine by a new process, and found free sulphuric acid, which was formed by the action of bi-tartrate of potash and sulphate of lime. The result was a compromise by the chemists, who considered that plastering might be done with moderation. In 1879 this question was brought for a third time before the committee, who did not admit the harmlessness of plastering, but said that two grams per litre were not dangerous.

M. Marty, in his report just published, settles the question from a hygienic view. He reports upon several experiments which have been made to show the harmlessness of wine plastered to 4°. All these experiments fail for want of precision or exactness in their method. It is an incontestable fact that plastered wines have occasioned functional troubles and organic injuries. All familiar with medical science know that a solution of acid sulphate of potash, in which sulphuric acid is in a free state, acts as a purgative, and a caustic in certain cases. In regard to the abolition of plastering, the hygienic committee are not unanimous in their decision. It is the opinion that a moderate plastering is necessary for the utilization, preservation, and transportation of a certain class of the poorer grades of wine, whose loss would be a disastrous thing for the wine-growers. But producers and merchants are warned, that, if they should continue the practice, the proportion of acid sulphate should not exceed two grams per litre. This proportion is sufficient to obtain the commercial advantages for which the lime is used. In conclusion, M. Marty examines and refutes certain arguments recently produced in favor of plastering. He recognizes the fact that the conditions of the non-combination of the neutral sulphate and the acid sulphate of potash are not well known, but says we have a law of nature that will guide the hygienists in the study of this question; viz., that natural wines never contain more than $\frac{65}{100}$ of a gram of the sulphate of potash per litre. The hygienists, on their side, do not ignore the fact that this is the maximum dose, and if it is surpassed it will certainly injure public health. In conclusion, the academy gave it as its unanimous opinion that plastering wine was a custom detrimental to health, and petitions that the law of 1880 be rigorously enforced.

MOTIONS OF THE SOLAR SYSTEM.[1]

No other hypothesis has been suggested which offers such direct and complete answers to most of the questions which relate to the origin, structure, and unity of the universe, as Newton's law of gravity. It is but natural, therefore, that the majority of the problems which arise in regard to the motions of the solar system should have their origin in an effort to confirm that law.

The first attempt to apply Newton's law to all the motions of the solar system was made by Laplace. When, however, Lindenau and Bouvard undertook to compute their tables of the motions of the planets, a complete revision of Laplace's theory was found necessary. So enormous is the labor involved, that there exists, besides those mentioned, only one other complete set of theories and tables of the motions of the principal planets, — that of Leverrier. Leverrier's tables of the inner planets are now nearly thirty years old. His tables of the outer planets are much later, having employed his attention almost to the day of his death. His tables of Jupiter and Saturn were published in 1876, and those of Uranus and Neptune in the year following. Newcomb's tables of Neptune were published in 1865; those of Uranus, in 1874. Hill's theory of Jupiter and Saturn, which has for years occupied his attention, has at last been completed, and he is now engaged in preparing tables therefrom. These are intended to form a part of a complete series of tables of the principal planets now being prepared under the direction of Professor Newcomb at Washington. Another such series is also being prepared by Professor Gyldén at Stockholm.

The values of the co-efficients of the terms of short period in the motions of the principal planets are now pretty well known; and the same might be said of the secular variations, were it not for the difference between theory and observation which exists in regard to the motion of the perihelion of Mercury, which was discovered by Leverrier, and has been confirmed by Newcomb, in a discussion of the observations of the transits of Mercury, extending over a period of more than two centuries. The cause of this difference still remains unknown. The completion and comparison with observations of the new theory of the four inner planets, now being prepared under the direction of Professor Newcomb, will be awaited with interest, with the hope that it may throw new light on this interesting subject.

The only recent original tables of the moon's motions are those

[1] Abstract of an address before the Section of Mathematics and Astronomy of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15–22, 1888, by Ormond Stone, vice president of the section.

of Hansen. These, like Leverrier's tables of the inner planets, are now more than thirty years old. These tables have been compared with observations, and agree fairly well with those made during the century preceding their publication, but not with those made before or since that time. The theoretical value of the acceleration of the moon's longitude is 6″; that found by Hansen from accounts of ancient total eclipses of the sun, 12″. Newcomb, however, considers these accounts as unreliable, and, limiting himself to the Ptolemaic eclipses of the *Almagest* and the Arabian eclipses of th *Table Hakémite*, obtains the value 8″.3, or, from the Arabian eclipses alone, 7″, — a value but little greater than the theoretical value. Dr. Ginzel, from an extended examination of accounts of ancient and mediæval total eclipses of the sun, concludes that Hansen's value requires a change of only a little over 1″. His solution, however, in reality depends upon the ancient eclipses alone. The only other theory of the moon comparable with Hansen's is that of Delaunay. This theory, however, is limited to a determination of the inequalities in the motion of the moon due to the action of the sun, on the hypothesis that the orbit of the earth is a pure ellipse, and differs from that of Hansen in that the inequalities determined are not expressed numerically, but only symbolically in terms of arbitrary constants.

While the co-efficients of the inequalities upon which Hansen's tables are based seem to be pretty well known, I am not aware that the tables themselves have been sufficiently checked, except by comparison with observations. Apparently the great desideratum now is a set of tables computed from Delaunay's theory in a completed form, or computed in some other way entirely independently of Hansen's. Until Hansen's tables are thus checked, it is questionable whether it can be safely said that the motion of the moon cannot be completely accounted for by the law of gravity.

The detection of the two satellites of Mars by Professor Hall may be considered the most interesting recent achievement in pure discovery. It was not till the discovery of these satellites that a means was offered for the accurate determination of the mass of that planet. No satellites of Venus and Mercury have as yet been detected, and the values at present assumed for the masses of those planets are very uncertain.

In 1788, just one hundred years ago, Laplace published his theory of Jupiter's satellites. This theory is still the basis of the tables now in use. Souillart's analytical theory of these satellites appeared in 1881. The numerical theory was completed only within the last year, and the tables therefrom remain still to be formed.

Bessel made a careful investigation of the orbit of Titan; but the general theory of the Saturnian system which he commenced, he did not live to finish. Our knowledge of the motions of Saturn's satellites, with the exception of Titan, was very meagre until the erection of the great equatorial at Washington. A difficulty in the determination of a correct theory of the motions of Saturn's satellites is the fact that there are a number of cases of approximate commensurability in the ratios of their mean motions. The most interesting case is that of Hyperion, whose mean motion is very nearly three-fourths that of Titan. In this case there is the additional difficulty that their distance from one another is only about one-seventh as great at conjunction as at opposition.

Our knowledge of the motions of the satellites of Uranus and Neptune depends almost entirely on the observations made at Washington. Quite accurate determinations of the masses of these two planets have been obtained. The large secular motion of the plane of Neptune's satellite, to which Marth has called attention, needs confirmation.

The number of the asteroids is so great that they have been the frequent subject of statistical investigation. The systematic grouping of the nodes and perihelia which exists was shown by Newcomb to be the effect of perturbation. Glauser finds that the grouping of the nodes on the ecliptic is a result of a nearly uniform distribution on the orbit of Jupiter. Professor Newton had previously found that the mean plane of the asteroid orbits lies nearer to the plane of Jupiter's orbit than to the orbit plane of any individual asteroid. Eighty-five per cent of the asteroids have mean motions greater than twice and less than three times that of Jupiter; and the mean motions of none approximate closely either of these, the two simplest ratios possible. The next simplest ratios lie beyond the limits of the zone; that is, there are no asteroids having mean motions nearly equal to or less than one and a half times that of Jupiter, and none nearly equal to or greater than four times that of Jupiter. The labor of determining the general perturbations and computing tables of an asteroid is as great as in the case of a major planet. It is no wonder, therefore, that tables have been prepared for scarce a dozen of these small bodies, and that these are already out of date.

Of well-known comets of short period, Encke's, which has the shortest period of any, possesses the greatest interest to the student of celestial motions, since it was from a discussion of the orbit of this comet that Encke detected evidence of the existence of a resisting medium which produces an acceleration in the comet's mean motion. This acceleration has been confirmed by the investigations of Von Asten and Backlund. The investigations of Oppolzer and Haerdtl indicate that there is an acceleration also in the mean motion of Winnecke's comet.

We have thus glanced briefly at the present condition of our knowledge of the motions of the principal bodies of the solar system. Only four cases have been found in which we cannot fully explain these motions, so far as known, by Newton's law of gravity. The unexplained discordances are the motion of the perihelion of Mercury, and the accelerations of the mean motions of the moon and the two periodic comets just named.

If we go beyond the solar system, we cannot tell whether Newton's law does or does not apply without modification to all parts of the universe. It is principally in the hope of answering this question that double-star observations are carried on; and, in the case of the many binary systems already detected, Newton's law is satisfied within the errors of observation. Nevertheless, this evidence is purely negative, and its value, it seems to me, not at all commensurate with the labor expended upon it, unless it be in the case of such objects as Sirius, whose observation may assist in the solution of the problem of irregular so-called proper motion. The angles subtended are in general so small that relatively large personal errors are unavoidable; so that, even though their motions be controlled by a law or laws of gravity widely different from that of Newton, it is not likely that such differences can be proved with any degree of certainty. It is rather to the study of the proper motions of the fixed stars and of the nebulæ, and then only after a lapse of hundreds and perhaps thousands of years, that we must look for a solution of this question.

SOME PHASES IN THE PROGRESS OF CHEMISTRY.[1]

SINCE the isolation of oxygen by Priestley, the search for new elements has been carried on vigorously, and the facilities for this pursuit have been much increased by the use of the delicate spectroscopic methods. The result has been to continually extend the list of bodies which are grouped under this head. The announcement of new discoveries during the last ten years has been especially large, over seventy bodies having been added to the list during this time. The largest number added by any observer has resulted from the joint labors of Krüss and Nilson on the absorption spectra of the rare earths, and reaches to over twenty. Should these discoveries be verified, the possible number of compounds which would result is something enormous, but, judging from experience, few are likely to survive a very searching inspection; yet one of them, 'germanium,' discovered by Winkler in 1886, has already been accepted as one of the missing elements in Mendelejeff's scheme, whose existence and properties he predicted.

Since the unit weight of hydrogen is taken as the standard for comparison, while the determination of the atomic weights of a large number of the elements has been made only through the intervention of oxygen, the ratio of the atomic weights of these two elements is the most important one to be determined, and many attempts have been made to solve this problem. The older experiments of Dumas and others were recently subjected to a careful scrutiny, and it was shown that they were not sufficiently exact. As

[1] Abstract of an address before the Section of Chemistry of the American Association for the Advancement of Science at Cleveland, O., Aug. 15-22, 1888, by C. E. Munroe, vice-president of the section.

the determination of atomic weights is of the greatest importance for the validity of the modern theories of chemistry, many experimenters of the greatest skill devoted themselves to researches on this subject, and, by means of improved methods, results of great accuracy were obtained. All these researches are of great intrinsic value and interest; but nevertheless they show, that even yet, with all the advantages of purity of material, perfection of apparatus, and precision of methods, united to great skill and extensive attainments on the part of the experimenter, the attractive hypothesis of Prout yet remains experimentally unproved. Many hold that the failure in the proof has been due to constant errors in the experimental processes; but Meyer and Seubert, from an elaborate discussion of the determinations of the atomic weight of silver and of those of the other more important elements calculated by its means, declare that they all contradict Prout's hypothesis in its characteristic original conception, and that it must therefore be looked upon as having been disproved by experiments.

Crookes suggests a hypothesis which may account for certain of the discrepancies in the atomic-weight determinations without resorting to the supposition of constant errors. He supposes that elements, instead of being composed of parts of matter which are identical throughout, are really composed of groups of particles which are only approximately alike, and whose weights only approximate to that average which we call the atomic weight. Hence it is possible that in different portions of such congeries different average values within small limits may obtain. Still it is remarkable that such close coincidences should result as have resulted from the observations made on material obtained from widely separated sources.

The determination of molecular weights is of nearly equal importance with that of the weights of the atoms. Thanks to Avogadro's law, we are able, when the substance can be obtained in the gaseous state, to determine its true molecular formula. When, however, the body cannot be completely volatilized unchanged, we have until recently been dependent upon isomorphism and the laws of molecular volumes and of specific heats, and upon analogical comparisons, to furnish us with estimates of the molecular weights. A new method of determining these weights was discovered by Raoult, who deduced a formula from the depression of the freezing-point of solutions. He showed, that by knowing the weights of the substance dissolved and of the solvent, and by knowing the depression of the freezing-point, the molecular weight may be calculated. He has examined a large number of substances whose molecular weights had previously been determined by their vapor densities, and the results obtained illustrate in a remarkable manner the accuracy and general application of this new method.

There has long existed a conviction in the minds of chemists that the molecular constitution of bodies in the solid state was much more complex than in the gaseous, owing to polymerization; and the opinion finds support in the diminishing density and increasing molecular simplicity of such bodies as acetic acid and sulphur when subjected to high temperatures. By analogy this aggregation of molecules should proceed as we pass from the gaseous through the liquid to the solid state. Is it not, then, singular that the molecular weights derived from Raoult's method for bodies in a state of solution should be identical, or approximately so, with those deduced from their densities in the state of a gas? This method fails to afford any indication whatever of this molecular complexity in solids and liquids. Must it not, then, be assumed that the solvent has effected the complete dissociation of the complex molecules present in it? If so, this probably extends to all cases of true solution without chemical action, if such there be; and this is assumed in this method, for, although the solvent used has been varied, it has given similar results.

Until recently we have known little precisely about the nature of solution. It has been held by some to differ essentially from chemical combination, but no satisfactory solution was offered until Mendelejeff made his important researches on this subject. He says, solutions may be regarded as strictly definite, atomic, chemical combinations at temperatures higher than their dissociation temperature. Definite chemical substances may be either formed or decomposed at temperatures which are higher than those at which dissociation commences. The same phenomenon occurs in solutions: at ordinary temperatures they can be either formed or decomposed. In addition, the equilibrium between the quantity of the definite compound and of its products of dissociation is defined by the laws of chemical equilibrium, which laws require a relation between equal volumes and their dependence on the mass of the active component parts. Therefore, if the above hypothesis of solution be correct, comparisons must be made of equal volumes. The specific gravities are the weights of equal volumes; and, moreover, we must expect the specific gravities of solutions to depend on the extent to which the active substances are produced: therefore the expression for specific gravity, s, as a function of the percentage composition, p, must be a parabola of the second order, while between two definite compounds which exist in solutions we must expect that the differential co-efficient $\frac{ds}{dp}$ will be a rectilinear function of p.

This theory has been proved by experiment, and not a single case was found in which it did not hold good. Later on, Crompton and Mendelejeff extended this theory to the discussion of electric conductivity of aqueous solutions, and the results have been very encouraging, being entirely in favor of Mendelejeff's theory of solution. Thus it is shown that even this seemingly simple process is very complex, and it is in the study of such processes that probably the most important progress in the theory of chemical processes will be made. This study will lead us to a clearer understanding of the properties of matter.

The evidence supplied by the various branches of chemistry has forced the conviction in the minds of many of the ablest chemists, that all matter is one, and varies only as it is acted upon by force; while, on the other hand, the transformations of energy which are continually to be seen occurring in nature and in art, as continually prove the truth of that glorious conception, the doctrine of the conservation of energy, and equally force the conviction that all energy is one, and varies only in its manifestations.

The belief in the unity of matter is as old as philosophy, and, as has been said, this belief has in recent times been strengthened to conviction by the development of such facts as I have alluded to above; and this conviction has been supported by the more recently discovered evidence that the properties of the elements are functions of their atomic weights, and that the elements, when arranged according to their atomic weights, fall into natural and periodic groups; for it is a fundamental deduction from the law of periodicity, that the various elementary atoms must be aggregations or condensations of one and the same primordial substance. Strong as the conviction resting upon this evidence may be, there is yet lacking the crucial proof; for we have as yet failed to observe the passage of matter from the form of one elementary substance to that of another, or the resolution of any element into or its creation from primordial matter.

The case for the evolution of the elements from periodical matter has been very ably summed up by Crookes, while, in addition, he has brought forward experimental proof of the possible existence of bodies, which, though neither compounds nor mixtures, are not elements in the strictest sense of the word. These bodies, which he styles 'meta-elements,' consist of different groups, which shade off so imperceptibly the one into the other, that it is impossible to erect a definite boundary between any two adjacent bodies, and to say that the body on this side of the line is an element, while the one on the other side is non-elementary. Yet by means of fractionation these bodies may be separated one from the other, and then they exhibit slight spectral differences.

Finally Grünwald has announced that during a mathematical investigation of the changes which the properties, and especially the spectra, of two bodies undergo when they unite to form a new substance, he discovered a simple and important proposition of a future chemico-mathematical theory of perturbations; and by its means he has shown the compound nature of hydrogen and oxygen, and has demonstrated the dissociation of hydrogen in the sun. The method employed is a spectral one, and requires conditions which cannot be reproduced at the will of man; so that if it stands the tests of criticism, which is doubtful, it will not then enable us to witness the evolutionary process in actual operation.

Hence we find for the doctrine of evolution in the domain of chemistry, that the tests yield absolute results when applied to

compound matter; but the extension of the doctrine to the genesis of the elements is a pure speculation, and bids fair at present to be incapable of absolute proof.

ON THE INTERNATIONAL GEOLOGICAL CONGRESS, AND OUR PART IN IT AS AMERICAN GEOLOGISTS.[1]

THIS association, at the meeting in Buffalo in 1876, appointed a committee to consider the propriety of holding an international congress of geologists at Paris during the international exhibition of 1878, for the settling of obscure points relating to geological classification and nomenclature.

Through the efforts and influence of this committee a congress was held in Paris in 1878, at which representatives from this country and from almost all the countries of Europe were present, and the business of the congress as indicated above was fairly begun. A second meeting was held at Bologna, Italy, in 1881; a third at Berlin in 1885, at which some progress was made; a fourth meeting is to be held in London in September of this year, and it is to be presumed that further progress will be made in the two important subjects before it, — classification and nomenclature.

But a meeting of the congress must be held in this country, and American geology must be fully represented, before any conclusions can be reached which will be accepted by the scientific world. At the meeting in London an effort will be made to have the next meeting, that of 1891, held in this country. There is good reason to ask that a meeting be held here before the discussions on the important topics under consideration are closed. We think our field of observation an important one, better than that of any of the countries of Europe, and perhaps better than all combined. This was the opinion of the older geologists; and such, too, is the opinion of many active geologists of the present day. Therefore we may look for the geological congress here three years from this time.

With this early notice of what is expected of us, it becomes us to make our preparations to show what we have done in geography and geology, and to enforce their claims to acceptance, as part of the material to be used in providing for uniform classification and names. As a profitable way of beginning our work, we inquire what are the points in each of these sciences which are settled, and what still remain to be worked out.

The foundation of all geological work is a good, reliable map of the country. Our country has greatly suffered from an inaccurate knowledge and description of our boundaries, in the north-east as well as in the south. Similar difficulties were encountered by the inaccuracy of surveys of State boundaries and land grants. It is true, these are not the points of interest in our association; but they furnish most potent reasons for making accurate maps, and they cause the supplies to be granted for making such maps. Good work in this line has been done by the Coast and Geodetic Survey and several other institutions, and its prosecution should be urged as rapidly as possible. But attention must be paid also to the topographic features, which are of equal value to the engineer, the farmer, the business-man, and the geologist.

The United States Geological Survey began systematic topographic work several years since, and it is now in progress in different sections of the United States. The maps are being engraved in the best manner, and issued as fast as they are completed.

We are far behind the countries of Europe in respect to maps of the whole country; but it is believed that our later maps will not suffer in comparison with the best of those of foreign lands, and, from some experience in directing such surveys, I feel warranted in saying that no public expense incurred in carrying on scientific explorations meets with such hearty recognition and approval as that for making and publishing such information in regard to the topographic features of the country in which we reside or travel. To us, however, geography is of most interest, because the forms and features of the earth's surface furnish a guide to direct us in our geological studies, and a means of recording their results with accuracy and clearness.

Geology, which treats of the structure of the whole earth, and which includes in its domain facts ascertained and principles deduced from all its parts, was first systematized from a very limited portion of the globe. It is not surprising that a system arranged consistently with the facts in a single country should not be comprehensive enough to meet the circumstances of all others. American geologists began by transferring the German, English, and French systems to this country. It took little time to find they did not fit the circumstances here; but, with that reverence for authority which is due from the younger to the older, we have been trying to make our geology conform to theirs. The effort is only partially successful, and we have to admit that something larger and more far-reaching must be devised before the science can be called a general one, applicable in all places.

It was probably some clear perception of this want in the science which led our fellow-members to move for an international congress of geologists, and now it is our part to see where the deficiency lies, and to do what we can to make preparations for supplying it.

The time is very short since geology was first studied in any systematic way in this country, and the advances have been rapid and large. From the time of Maclure's 'Observations on the Geology of the United States of America,' begun in 1809, and the establishment of Silliman's *American Journal of Science and Arts*, the growth of American geology has been rapid and plainly marked. The *American Journal* itself continues to be a repository of the advances of geological science. The Academy of Natural Sciences began the publication of geological papers the same year. During the ensuing twenty-three years, numerous surveys and reports were made, and the progress of geology was rapid.

On April 2, 1840, a meeting was held in Philadelphia, and the American Association of Geologists and Naturalists was organized. Of the eighteen present, thirteen or fourteen were geologists fresh from the field. The proceedings of the meeting, which was continued through a second and third day, are of interest to us as showing the problems which occupied them, something of the questions then settled, and of those on which they sought information and advice. Professor Hitchcock exhibited specimens of 'fossil footmarks so called,' and the association appointed a committee to visit the localities, and to report at the next meeting. The subject of diluvial action was discussed at this and the subsequent meetings.

Meetings were held by the association in the successive years, 1841 to 1847 inclusive, and it was then resolved into the American Association for the Advancement of Science, the first meeting of which was in 1848. The Section of Geography and Geology, now Section E of the American Association, is the representative of the society organized by American geologists to collate the individual work of each other, and to bring them into harmony of succession and name. It has already done much, and has reached the position from which it is prepared to do much more.

Many and perplexing questions have arisen in the progress of geology, some of which have taxed the powers of our ablest men. By continued efforts they are being solved. The Taconic question, the triassic formation of New Jersey, Pennsylvania, and the States farther south, the place of the American trias in the geological column, and other problems, received due attention at the meetings of the association. Some of these vexed questions were solved; in others considerable progress was made.

In the International Geological Congress the two topics for examination, and, if possible, for agreement, are the general system of nomenclature, and the colors to be used in making geological maps. It is, however, perfectly obvious, that, before agreeing on names to be used, the objects to be named must first be agreed upon; and it is evidently from the lack of completeness in the geological column in any single country where the geology has been well studied and described that the first difficulty arises. The order of succession of the rocks has been published, and names have been given to them; and, now that these have been in use, it is difficult to so change them as to make them a part of a scheme that shall be of universal application. It was this end which our association aimed at in their resolution passed in 1876; and, while progress has been made in the work at each meeting since held by the congress, it is

[1] Abstract of an address before the Section of Geology and Geography of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15–22, 1888, by George H. Cook, vice-president of the section.

still in a very mixed condition. Great difficulties arise from the different languages spoken by the representatives of the several nations represented. Another difficulty arises from unequal representation. The attendance is voluntary, the members pay their own expenses, and the time and money required must hinder many who are deeply interested from attending the meetings; and this hinderance is greater in proportion as the distance from the place of meeting increases. The attendance shows this: at the Paris meeting there were 194 Frenchmen and 110 foreigners; at the Bologna meeting there were 149 Italians and 75 foreigners; and at the Berlin meeting, 163 Germans and 92 foreigners. This, it will be seen, does not give general geology a fair representation when questions come up which are to be decided in favor of the majority voting on them. Such votes can only be tentative, and the decisions will hardly be acquiesced in until a more equable representation is brought to act upon the unsettled questions, and many more countries have been fully represented. They do, however, bring out the questions upon which action is to be taken, and prepare the way for a right decision. The congress at Berlin aimed to embody the present condition of European geological science and cartography by preparing a map of Europe in which the legend gave all the larger known divisions of the geological column, and the colors on the map showed their locations.

As it stands now in the list of names drawn up by the congress, we are reminded of the remarks of Whewell, made more than fifty years ago, that the advancement of three of the main divisions of geological inquiry has during the last half-century been promoted successively by three different nations of Europe, — the Germans, the English, and the French. The study of mineralogical geology had its origin in Germany; the classification of the secondary formations, each marked by their peculiar fossils, belongs in a great measure to England; the foundation of the third branch, that relating to the tertiary formations, was laid in France.

With the great accessions which have been made to the general stock of geological knowledge by American geologists, and the general publication of it, it becomes necessary that this should be incorporated in a work which is designed to be comprehensive enough to take in the geology of the world. This list of names for the members of the series undoubtedly satisfied the Europeans who voted upon them; but they are too local, too geographic, too strange, to have a place in any general series. Names must be given in describing new kinds or occurrences of rocks; but they should be provisional, and dropped whenever some more characteristic or generally appropriate name can be found. For calling attention to the several divisions, these names will be very useful, and by their general publication they can be brought to the consideration of hundreds of working geologists, who by their contributions and suggestions can throw light on the subject, though they may never be able to attend an international geologial congress. The advancement of science in modern time is brought about much more by the increased number of workers in the cause than it is by the greater attainments of a few men. With attention properly drawn to this position of geological science, with a great body of workers in the field, with an immense territory in which to work, and with a notice of three years in advance, we can prepare the case so as fairly to present the claims of American geology to a representation in a general system of geology. The congress went no farther in the lists of names: those of the fourth, fifth, and sixth order will be still more difficult to generalize, and it may be that it will be found expedient to leave the names of these orders to be given in the languages of the countries where they find their application.

It might tend to a more equitable representation of the views of members from different countries, if the number of votes to which each country should be entitled could be equitably settled, and the representation from each country should be in some way controlled by the whole body of geologists; but in a country like ours, where most geologists have active duties to discharge in the milder seasons when meetings are held, this cannot always be had. Besides, the work calls for an individual sacrifice of money and time, which many persons think they cannot properly make, either for the public good or for the benefit of science.

These are difficulties which attend the present arrangements for work; and at present I can only bring them to your attention without offering any suggestions for their solution. The objects of the congress are worthy and useful ones, and they will be attained. To us they give direction and point to our investigations and studies, and they will be profitable by leading us to a fuller examination of the whole field of geological science as well as to a more careful and demonstrative study of special fields in which our individual work lies.

ALTRUISM CONSIDERED ECONOMICALLY.[1]

THE primary motive of human action has always been the care of self, this being for man nature's first and greatest law. In his unthinking zeal he has often followed this to a degree unnecessary, and consequently harmful to others. In his savage state, and especially in his primeval condition, where he was subject, like all the lower forms of life, to the law of "the survival of the fittest," he could not consider others' interests, because they were so antagonistic to his own. Often one of two must starve, and each would let it be the other one. He did not even become conscious that he was so acting for a very long period of time. It was the progress from a being not human to the being called man when sufficient intelligence had accumulated to make him conscious that he could live and let live. That point was also marked by and synchronous with the acquirement of such weapons and such skill as enabled man to procure food enough to make the starvation of some unnecessary. Then the war for the survival of the fittest, as known to biology, ceased among men. Ever since, so far as there has been a struggle affecting the survival of the fittest (and that struggle continues to the present day in certain ways), it has been of a different sort, and one which must not be confounded with the biologic law of the survival of the fittest. Major Powell has admirably shown how the strictly biologic struggle has ceased in man; but he has not yet shown, as may be, the character of that struggle, largely intellectual, which still works out certain survivals of the fittest.

Having passed from the point where, if he survive, it must be at the expense of others, man began to recognize and to consider the desires of his fellows; and among others he counted not only his fellows, but mythical and supernatural beings. Thus appeared the greatest natural basis of religion. It is not strange, therefore, that religion should have existed from very early times, and that it should have taught its votaries especially to regard the needs of others. Its mission was to teach a race whose ancestors had been absorbed for untold ages in caring only for self, to adapt itself to a new environment by learning to care for the wants of others. In caring for others the more powerful soon received superior recognition, so it came to pass that supernatural demands took precedence of the rest. When that point had become clear, men were easily tempted to profess to represent the gods, in order that they might share the precedence. In this natural way became established the order of duty which was taught by every religion prior to Christianity; viz., 1. To the gods and their representatives, 2. To self, 3. To others.

Early Christianity must be credited with changing the order of duty to the following: 1. To its one supernatural being, 2. To all others equally with self.

Even under this improved system, many people are led to make great personal sacrifices, in the belief that thereby they are living the noblest life possible to man, when in reality, as it is the object of this paper to show, their sacrifices are either useless, or, what is worse, grossly injurious both to themselves and to the supposed beneficiaries.

During all the untold years in which it was a physical necessity to regard self even to the injury of others, our ancestors acquired a predisposition thereto which heredity has brought down the stream of time. As being no longer a necessity, its practice long since became one of the recognized evils of the world. We apply to it the opprobrious epithet of 'selfishness.' There is a better term, and one which does not imply a moral quality, for there may be devotion to one's own interests which should not be so characterized. Egoism is such devotion to one's own interests: it may be proper,

[1] Abstract of an address before the Section of Economic Science and Statistics of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15-22, 1888, by Charles W. Smiley, vice-president of the section.

and it may be improper. The term does not imply either propriety or impropriety. Let the word 'self-interest' stand for justifiable egoism, and the word 'selfishness' represent unjustifiable egoism.

Egoism, then, was once a necessity; and while it was a condition to existence, it was justifiable, whatever its effects on others might have been. When things changed so as not to render egoism a necessity, man was still as prone to practise it as before. He was acting under the acquired impulses of ages. It was an extremely difficult thing for him to repress his egoism; it was perhaps even more difficult for him to understand that he ought to do so. And yet the change of circumstances had produced a change in its moral quality. From the practice of self-interest he had passed to the practice of selfishness; and he had so passed unconsciously, for the change was in environment, and not in him. The same act that had been a virtue was now a vice. Of course, centuries were needed for this idea to develop and to be disseminated, but at length it came. Although the terms were not in use, the differentiation had taken place. The terms came when needed to express existing ideas.

Long after egoism had differentiated into self-interest and selfishness, came the idea of doing something for others. Man's powers were then so limited that this was not much. Even when he became capable, he was slow to discover it, and slower to act upon it. Heredity bound him. To loosen him was the mission of religion. Whatever its votaries may claim as to its history and purpose, the one great and overwhelming power that religion has had upon the world is this, — it has developed doing for others; it has turned man's attention away from himself to those not himself. A most excellent term to use for this is 'altruism,' — a term first employed only about fifty years ago by Auguste Comte to signify devotion to others or to humanity. Percy Smith, in his 'Glossary of Terms and Phrases,' defines it as "the doing to another as one would be done by; opposed to egoism."

Such terms as 'benevolence' and 'charity' have been generally used to cover the idea of altruism; but in the mind of every one 'benevolence' and 'charity' involve the moral quality of goodness. It is of the greatest importance to have a word like 'altruism,' which does not imply any moral quality, and which covers all we do for others regardless of the consequences, just as 'egoism' covers all we do for self regardless of consequences or of moral quality.

That mankind has thus far regarded all altruism as good, is undeniably shown by the fact that neither English nor any other language has words to distinguish proper from improper altruism. This distinction has not been well developed. It was early seen that the motives were of importance. If we do something for others, it should be with a good motive. The act was declared to be of no subjective value unless the motive was lofty: thus, "Do not your alms before men to be seen of them, otherwise you have no reward of your Father which is in heaven." Calling attention thus to motives was doubtless a great advance upon the preceding times. This improved form of altruism was, however, indiscriminate. Nothing was said nor implied, in the above precept, as to the character of the persons to whom alms were to be given. Nothing was hinted nor thought of the ultimate effect upon the recipient of giving alms, much less of taking steps to prevent any needing alms.

For eighteen hundred years the world has had an altruism which failed to discriminate as to the object, and altruism has often been carried to injurious excess, and yet we have had about as good general results as could be expected under the circumstances. The early step from justifiable egoism to that which discriminated was a long one. From the mind resting on self to considering the immediate wants of others was a great advance. From altruism performed with selfish motives to disinterested benevolence was another grand advance. The order of human progress doubtless required a long discipline in indiscriminate altruism before men should learn to differentiate it by observing its results.

And yet, however grandly its maxims may ring in our ears, whatever praises we may bestow upon its advocates, and whatever satisfaction we may express with the past, the day for indiscriminate altruism has gone by, and we are confronted with present duty. To-day the only man who sells all that he has and gives to the poor is the unfortunate one whom we shut up in the insane-asylum. To-day the only one who takes no thought for the morrow is the tramp or the beggar (the professional beggar has even sense enough to keep a bank account). Those extremes of altruism, non-resistance and self-abnegation, have been discarded. And why? Let us now recognize the virtue in them, and understand also just why they are impracticable.

The virtue of those precepts lies in their power to draw men away from self.

He who sells all he has and gives to the poor, may, if he is very badly eaten up with greed for money, discipline himself in the right direction; but in selling *all*, he has deprived himself of the means of self-support in sickness, and endangered the care of his family. But all this of subjective wrong might be perpetrated to curb a grasping spirit through the loss of property. That, however, which he had no right to do, he has done. He has pauperized the poor. The evil inflicted upon scores, and perhaps hundreds, is in their lessening of self-respect, the cultivation of indolence, the enfeebling of their already weak determinations, the putting farther away of that day when the poor shall be properly paid for their work, and the fostering of that reckless spirit, "The world owes me a living, and I am going to have it." If the next rich man does not sell out and distribute soon enough, they will thirst for his riches, perhaps for his blood.

Every single precept pointing to non-resistance and self-abnegation, while subjectively attractive, ignores the objective and ultimate effect; that is, they all seem to be of benefit to the doer, but make not an iota of discrimination as to the effect upon others, while in fact, as history has shown, and as we are now beginning to know, both are injured, but the greatest harm is done to the supposed beneficiaries.

But to consider the economic effects of altruism by means of which we are to distinguish justifiable altruism from unjustifiable altruism. Now that we have reached the study of social, political, and economic science, we are called upon to analyze the subject, to define our terms carefully, to be sure that we build our sciences on facts, and to state our conclusions clearly. And our conclusions are most hopeful. They are, that in doing real and not seeming good to ourselves we also benefit the race, that in doing good to others it is not necessary nor wise that we inflict sore deprivation or indignity upon ourselves, that thrift and wisdom consist in taking a reasonable thought for the morrow, and that in nothing so much should we take anxious thought for the morrow as when appealed to for alms or to assist the needy.

Better that they suffer hunger to-day and be made self-respecting and self-supporting to-morrow, than that they be fed to-day and then be forgotten to-morrow. We best help others by securing them full justice, and by refraining from injuring them either through malice or through giving them that for which they return no equivalent.

[Of the different forms in which altruism has been exercised in the past, Mr. Smiley has little to say in praise. As to the relief of the poor, he quotes the results of Mr. Low's investigations in Brooklyn, and of similar investigations in Cleveland and Cincinnati, where it has been found, that, with the cessation of out-door relief, the need of such relief has nearly vanished. He maintains that it should always be regretted when circumstances seem to demand attention to immediate needs, and that, if a friendly visitor is permitted to give alms, his and the minds of the receivers are diverted from the great object, — the permanent cure of poverty. Orphan-asylums and foundling-asylums he also severely condemns, holding that every foundling-asylum in America should be instantly disorganized; and in speaking of insane-asylums he considers it surprising, that, while rapid progress is being made in treating many forms of disease, so little knowledge is being obtained concerning the nature, causes, and cure of insanity, and insists that doing good to those now insane may not be of half the importance that it is to find means of preventing insanity in the future. Under the heads of 'Benevolence in Higher Education' and 'Gifts to Workingmen,' he refers to the free education of certain classes of students, which practice he believes to be dying out, and to the fashion which wealthy people have of establishing chapels and libraries for the use of the working-classes. He believes that the working-men

need none of these charities, but that they cry for fair wages and reasonable rents, and they will furnish their own chapels, their own libraries and reading-rooms.]

BOOK-REVIEWS.

Three Cruises of the United States Coast and Geodetic Steamer "Blake" in the Gulf of Mexico, in the Caribbean Sea, and along the Atlantic Coast of the United States, from 1877 *to* 1880. By ALEXANDER AGASSIZ. 2 vols. Boston and New York, Houghton, Mifflin, & Co. 8°. $8.

FEW general readers are aware, or at least appreciate, the very great advances that have been made during the last two decades in our knowledge of the deep sea and its life. With the researches of the lamented Pourtales, and the famous voyage of the 'Challenger,' a new epoch was entered upon in the science of thalassography, as our author aptly calls it, that has brought a vast amount of light upon many vexed problems in biology as well as geology; and in the results already attained America justly lays claim to a large share of the credit. The deep-sea soundings and dredgings carried on with the 'Hassler' and 'Blake' of the United States Coast Survey, and more recently with the 'Fish-Hawk' and 'Albatross' of the Fish Commission, have been of the greatest importance.

A score of years ago, with the old line and sinker, depths of eight thousand fathoms were reported with "no bottom:" now the improved machinery and steel-wire lines have brought up mud from the bottom at over four thousand fathoms, and accurate soundings have reached 4,655 fathoms. The 'Blake' made dredgings at the very great depth of 2,400 fathoms in an hour or two's time: by the older methods twenty-four hours were consumed in dredging from half that depth. With the electrical thermometer, accurate readings of the temperature of the water at any depth the sounding-line can reach may be read from the ship's deck, and specimens of water from near the bottom may be brought to the surface, uncontaminated, for analysis. With all these improved appliances, it is not too much to expect that not many years hence accurate contour-maps will be made of all the more important deep-water bottoms, and a vast deal added to the knowledge of the physical conditions and life of the deepest oceans. What light such knowledge may throw upon the physical conditions of our globe and its geological history one cannot foresee, though surmise.

So, too, the deep-sea life, and the conditions under which it exists, are of interest in themselves, as well as for the relations they bear to others. That the normal conditions of life may exist under a pressure of two or three tons to the square inch, may seem remarkable; but it is more remarkable that the same species may adapt itself to the extremes of pressure, or that the same individual may exist indifferently under differences very many times greater than can the terrestrial animal. "Fishes and mollusks are apparently the only animals which show very markedly the effect of diminished pressure. In fishes brought up from deep water, the swimming bladder often protrudes from the mouth, the eyes are forced out of their sockets, the scales have fallen off, and they present a most disreputable appearance." It is not believed that light can penetrate over four hundred fathoms; nevertheless, Professor Agassiz states that "by far the majority of the animals living at a depth of about 2,000 fathoms have eyes either like their allies in shallow water, or else rudimentary, or sometimes very large." What an animal can need of eyes for perpetual life in intensest darkness is hard to say; but perhaps the presence of eyes, and ornamental coloration, in these deep-sea creatures, may mean that rays of light, perhaps the non-actinic ones, may reach even two or three thousand fathoms.

But space will not permit us to touch upon the many interesting topics of this work. Suffice it to say that the two beautifully printed volumes treat very fully of the general methods of thalassographic work, and the physical conditions and faunæ of the deep Atlantic Ocean, Gulf of Mexico, and Caribbean Sea. The work has over five hundred and fifty excellent engravings, the larger part illustrative of characteristic deep-sea types of life. As a sound and permanent contribution to the literature of the deep sea and its inhabitants, the author is justly entitled to great credit.

Entomology for Beginners, for the Use of Young Folks, Fruit-Growers, Farmers, and Gardeners. By A. S. PACKARD. New York, Holt. 12°. $1.40.

IT has been said that a good entomological text-book is one of the most difficult tasks that an author can undertake; and when we consider that there are a million kinds, more or less, of greater and lesser bugs (as the laity will persist in calling insects) in existence, and a great, if not corresponding, variety in their structure and habits, it is not to be wondered at that general entomologists are very few. A high authority upon beetles or butterflies may be, and generally is, very ignorant upon the subjects of bees and bugs, and *vice versa*. The trouble is, the entomologist is yet too busy cataloguing new discoveries, and, as a million more names will be needed before *finis* is reached, he feels no concern except for his own immediate part of the task.

Books, good, bad, and indifferent, there have been in plenty upon insects. The descriptive literature of the two hundred thousand kinds already made known alone must equal that of all the rest of the animal kingdom. But of books that may be classed as serviceable text-books on general entomology, there are very few indeed. Westwood's classical 'Introduction,' Harris's 'Injurious Insects,' and Packard's 'Guide,' have been about the only ones in the English language till lately. It is therefore with the more pleasure that we welcome the present work from the pen of a well-known author and entomologist. We are disposed to find fault with its title, for it really is a better guide to the study of insects than the author's larger work. If there is any thing else, except trivial details, that we would criticise, it is that the author has attempted to compress too much into so small a volume, and that some parts are not as thoroughly arranged and digested as they should be. Its merits are, that it gives in simple language the information and instruction needed by the student who has a fancy or passion for collecting insects, as regards their habits, structure, classification, collection, preservation, and study; and for this purpose we believe it to be the best in the language. To the farmer and horticulturist it will be of less, though considerable, value.

An Elementary Course in Descriptive Geometry. By SOLOMON WOOLF. New York, Wiley. 8°. $3.

THE present text-book is a good introduction to the study of descriptive geometry, its principles and methods being set forth concisely and clearly. After a brief discussion of the principles of projection, the point, the line, and planes and surfaces, are fully discussed. The author has selected the problems so as to elucidate the properties of all geometric combinations, and thus to give the student as well a clear understanding of the methods of descriptive geometry as the greatest possible practice in the use of these methods. Their practical use is always kept foremost before the mind of the student. Thus the use of supplementary planes and projections is introduced by emphasizing the necessity of using special constructions for making clear the character of the object to be represented, and for lessening the constructive difficulties of the case. The methods of rotation and rabattement used for this purpose are fully discussed. The whole field of descriptive geometry is thus treated, the problems being illustrated by numerous clear cuts. The properties of the projections of angles and sections, intersections and tangents, are fully discussed, while the book closes with a chapter on development of surfaces. The conciseness and clearness of the treatment, and the practical arrangement of the material, make the book of great value to the teacher and to the student.

NOTES AND NEWS.

THERE was no address this year by the vice-president of Section D of the American Association.

— The officers of the American Association for next year are as follows: — President: T. C. Mendenhall of Terre Haute, Ind. Vice-presidents: Mathematics and Astronomy, R. S. Woodward of Washington, D.C.; Physics, H. S. Carhart of Ann Arbor, Mich.; Chemistry, William L. Dudley of Nashville, Tenn.; Mechanical Science and Engineering, Arthur Beardsley of Swarthmore, Penn.; Geology and Geography, Charles A. White of Washington; Biology, George L. Goodale of Cambridge, Mass.; Anthropology, Garrick Mallery of Washington; Economic Science and Statistics,

Charles S. Hill of Washington. Permanent secretary: F. W. Putnam of Cambridge, Mass. General secretary: C. Leo Mees of Terre Haute, Ind. Secretary of council: Frank Baker of Washington. Secretaries of sections: Mathematics and Astronomy, G. C. Comstock of Madison, Wis.; Physics, E. L. Nichols of Ithaca, N.Y.; Chemistry, Edward Hart of Easton, Penn.; Mechanical Science and Engineering, James E. Denton of Hoboken, N.J.; Geology and Geography, John C. Branner of Little Rock, Ark.; Biology, Amos W. Butler of Brookville, Ind.; Anthropology, W. M. Beauchamp of Baldwinsville, N.Y.; Economic Science and Statistics, J. R. Dodge of Washington, D.C. Treasurer: William Lilly of Mauch Chunk, Penn.

— Mr. E. T. Dumple, writing in the *Geological Bulletin* of Texas, brings out a very interesting fact, and one which may shed some light upon the question of who were the builders of the shell mounds of the coast regions of Texas. During the great storm of 1886, which so nearly destroyed Sabine Pass, one of these shell mounds, which was near a certain house on the river-bank, and the locality of which was exactly known, was destroyed or carried away by the violence of the waves, and rebuilt nearly half a mile farther up stream than it formerly stood. It is therefore possible that these so-called Indian shell mounds, which are composed almost entirely of shells, with fragments of pottery, and sometimes a crumbling bone or two, were not built, as has been supposed, by Indian tribes who lived on shell-fish, but are entirely due to the action of the water; and the presence of the Indian relics may be easily accounted for by remembering that these mounds are usually found in low ground, and, being high and dry, would naturally be selected as camping-places by the Indians in their hunting and fishing expeditions.

LETTERS TO THE EDITOR.

Our Native Birds.

IN *Science* for Aug. 3 there is an editorial on the re-appearance, in "woods and the meadows in the country," of large numbers of native birds, and it is queried why ornithologists have not offered some explanation of the fact. It is a difficult matter to remember about the number of birds seen from year to year, the exact time of their appearance, and the weather; and, unless some sort of a record is kept, mere unaided memory is often misleading.

I do not know how it is in other places, but on Staten Island there have been no more birds this past spring than in former years, though the cold weather delayed them somewhat in their progress northward, as it so often does. On the 22d of April I saw two swallows, yet on the 25th water froze. On the 2d and 3d of May the warblers came in numbers, and the usual annual ogling with a glass was gone through with.

This summer, also, apparently no more birds have built on the island than there did last; and the number of nests belonging to robins, cat-birds, and chippies in the garden and vicinity has not been added to.

We really suspect that the careful observer has not seconded the popular account of the great bird-visitation, for the reason that he has recorded many others just like it, and believes, as Carlyle says in 'The Sower's Song,' that "this year will be as the years that are past have been." WM. T. DAVIS.

Tompkinsville, N.Y., Aug. 10.

YOUR interesting statement in *Science* of Aug. 3, regarding the return of birds to their deserted haunts in the North and West, prompts me to say that I have noticed this year in this vicinity a remarkable decrease in the number of such migratory birds as nest here.

Orioles, red-birds, and cat-birds are generally quite numerous in this region, and last year impressed themselves upon the memories of the people who cultivate grapes and other small-fruits. This year they are noticeably scarce, and have done very little harm. Robins generally pass here in large numbers, moving South for a few days in the fall, and tarrying a month or more on their northward journey in early spring. During the latter period they are game to the small boy and negro pot-hunter. Last spring they were remarkably scarce.

On the other hand, the English sparrow is here. I noticed the first pair seen in this vicinity eight years ago. The house-marten, which once occupied the eaves of houses in the neighboring city of Oxford, has left in disgust, and the sparrows now monopolize all such desirable locations. This pest, I think, has invaded most of the larger towns in Mississippi, and other Southern States.

Can it be that native birds have concluded that they might just as well meet the invader in their old haunts, as try in vain to escape him by remaining South during the summer? R. B. FULTON.

University, Miss., Aug. 10.

I NOTICED a week or so ago in *Science* that part of the evidence of increased abundance of our native birds consisted of reports from Illinois. Perhaps I can cast some light on that point. I was in northern Illinois till the first of July. Up to that time there had been no signs of an unusual number of birds, except during one week. Then the fields, woods, and even the towns, literally swarmed with small birds for a few days. That was easily explained. It was just at the migrating season of the warblers, and they were bewildered and driven out of their way by a cold storm. Thousands of them died, apparently from cold and exhaustion. They could be picked up in the streets. For several days the papers were full of reports of the "thousands of *strange* birds." Every one said they were birds which had never been seen there before; but any one who has searched the woods knows how many of our birds are unknown to people in general. A considerable proportion of these birds were redstarts. I identified six species, I think, of warblers, but, not having my note-books by me, cannot be positive as to the number. Certainly all, or nearly all, were warblers, and none of them unknown visitants, though all uncommon in the thickly settled places. I believe it was from this occurrence that the report of an unusual abundance of native birds in Illinois originated. L. N. JOHNSON.

Bridgeport, Conn, Aug. 14

Queries.

34. ARE BATS DIURNAL? — Are bats ever known to be diurnal in their habits? While out fishing a few days ago in this vicinity, about two o'clock in the afternoon of a bright sunny day, I noticed over a pool in the river, perhaps a hundred feet in diameter, a bat as busy and happy, and apparently as successful in his pursuit of insects, as I have ever seen one at twilight. He snapped once or twice at my fly, giving me hopes of landing him. His color was brown, and to all appearance he was of the common species.

J. W. CHICKERING, Jr.

Dennysville, Me., Aug. 14.

35. MILK-SICKNESS. — During a summer visit to the North Carolina mountains, the writer heard much about the 'milk-sickness,' or 'milk-sick' as the natives call it. They seemed to apply the term indifferently to some peculiar disease there prevalent, and to a plant which is believed to be the cause of it. They believe that the cattle eat this plant, and that the disease is transmitted to human beings through the milk. We were repeatedly warned to be careful in our use of milk, especially when we were about to visit the Nantehala Mountains, for there the milk-sick was said to be especially troublesome. We went through those mountains, and heard of it often; but it was always somewhere else, never near at hand. There was one noteworthy exception. A lady with whom we took dinner assured us that there was plenty of it down on the creek, but that her cattle were kept in pasture, so there was no danger. There are said to be two doctors in the Nantehalas who understand the disease; and if either one of them can be reached in time, there is little danger, otherwise it is frequently fatal. The only remedy we heard suggested was apple-brandy and honey. We were unable to learn definitely what the symptoms of the complaint were, nor did we find out what the plant is which is believed to be so dangerous. Is there a well-defined and recognized disease due to this cause, or is it merely some form of fever to which the people are specially subject from their mode of life and surroundings? It almost seems as if there must be something in it, the belief in it is so general; yet, if I mistake not, I have seen the existence of any such disease denied by those who ought to know. L. N. JOHNSON.

Bridgeport, Conn., Aug. 17.

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SCIENCE

FRIDAY, AUGUST 31, 1888.

SOME VERY INTERESTING INQUIRIES are suggested by the statistics of the enrolment of pupils in the private schools of the country, which will appear in the forthcoming report of the National Bureau of Education. These statistics are necessarily very fragmentary, and some of them bear internal evidence of their incorrectness. But in a few States the reports are sufficiently full to indicate a tendency, at least. In Vermont, for instance, there was a decrease of .36 per cent in the enrolment of children in the public schools, while the enrolment in the private schools increased 3.57 per cent. In Connecticut the increase in the public-school enrolment was only .2 per cent, but in the private schools it was 5.13 per cent; and in New York the figures are .98 and 4.12 per cent respectively. But these percentages alone might be very misleading, since they are computed on different quantities. The actual statistics show that Vermont lost from her public-school enrolment in the year, 265 pupils, and gained in her private schools 259. In Connecticut the gains were 255 and 778 respectively; and in New York, 10,045 and 5,268. Some startling conclusions might be drawn from a superficial consideration of these figures as to the tendency of public opinion as to the relative value of public and private schools; but no confidence could be placed in them, owing to the absence of so many necessary elements of the problem. At the same time it is very desirable that the statistics of the private schools of the country should be collected with the utmost completeness and accuracy, and it is encouraging that Connecticut has already taken legislative action that should secure a complete system of private-school reports in the future, and that movements in the same direction are on foot in several other States.

REPORTS RECEIVED in Washington from Callao describe the sudden collapse of the paper money of Peru. Part of this currency, amounting to 20,000,000 soles, was issued by the banks at Lima ten years ago, and guaranteed by the government. The remaining 40,000,000 soles is government money. Its purchasing capacity declined several years ago to one-twentieth of that of silver, but, in the absence of any other circulating medium, it continued to be used by the people. Finally, in the brief period of ten days, confidence was lost in it so rapidly that it was virtually repudiated in all business transactions not directly connected with the government, which receives it in half payment for duties on imports, and pays it out to its employees. The amount of silver in circulation in Peru is very small. The banks and commercial houses of Lima and Callao could not produce 2,000,000 soles. The experience of Peru is but a repetition of that of every other country that has violated the scientific law in establishing as a circulating medium an article that has no exchangeable value itself, and is not made redeemable in a commodity that has — only more swift and disastrous.

WHEN A WRONG IS ASSAILED in general terms, the assault is apt to be interesting to those who participate in it, and perhaps to those who witness it; but there is some danger that it may not accomplish very much. This truth is illustrated by the results which have so far followed the attempts of various medical journals in this country to abate the evil of quack advertisements in religious newspapers. These attempts have been approved and applauded by medical men, and those who made them knew they were discharging a useful office. But the religious newspapers have not been cured; and, indeed, they do not seem to have improved materially. One of the reasons for this is, no doubt, the fact that the attack has not been sufficiently sharp on any portion of the line to break it, and that, while the whole religious press bore the brunt of the assault, no one part experienced any special inconvenience from it. The *Medical and Surgical Reporter*, believing that no reform is ever accomplished without somebody being hurt, now states that they shall not hesitate, when next they take this subject up, to lay hands on particular religious papers, and say plainly to the editor of each, "Thou art the man!"

CONVENTION OF AGRICULTURAL CHEMISTS.

THE convention of official agricultural chemists, composed of analytical chemists connected with the United States Agricultural Department, or with state or national agricultural experimental stations or agricultural colleges, or with state or national institutions or bodies charged with the official control of analysis of fertilizers, soils, cattle-foods, dairy-products, and other material connected with agricultural industry, met in the library of the Agricultural Department during the first week of August. About thirty members were present, including two delegates from Canada.

The method of this convention is to distribute samples in advance to all its members, upon the analysis of which they make reports, the object being to secure uniformity of methods and results. Previous to last year, fertilizers only were analyzed. A year ago there were reports on dairy-products, and cattle-foods were added; and this year fermented liquors and sugars. The analyses this year showed, that, following the methods adopted by the association, the older and more experienced official chemists arrived at as uniform results as could be expected, — entirely satisfactory ones, — but that there was great room for improvement among others. Following the same methods, some of the chemists reach very widely differing results.

One encouraging fact was mentioned by the secretary, and that was the very general recognition which the association is receiving from the manufacturers of, dealers in, and users of fertilizers. This has been shown by the great demand for the bulletin of the association, the edition of which for last year was exhausted several months ago, with the call for it still continuing, and by the numerous letters received by the secretary, expressing a desire, on the part of all those interested in the manufacture, sale, or use of fertilizers, to conform their methods of analysis to those adopted by the association. Those interested in other articles subjected to analysis by the association will probably show the same interest when the extension of its work becomes known.

By a change in the constitution, all members of the association who lose their right to membership by retiring from the positions that entitled them to it, may become honorary members, and exercise all the privileges of membership except the right to hold office and vote. It is believed that this amendment will secure the continued interest and co-operation of those who would otherwise cease all connection with the association.

Another amendment of the constitution places the selection of subjects for discussion, and the distribution of samples, in the hands of a number of 'reporters,' appointed by the president, to each of whom certain topics are assigned. These are to take the place of the committees.

The officers chosen for the ensuing year were, Prof. J. A. Meyers of West Virginia, president; Prof. M. A. Scovell of Kentucky, vice-president; Prof. Clifford Richardson of Washington, secretary; Profs. William Frear of Pennsylvania and H. W. Wiley of Washington, executive committee.

PROCEEDINGS OF THE AMERICAN ASSOCIATION.

THE work accomplished in the various sections of the American Association for the Advancement of Science is very satisfactory if considered as a whole. The number of members attending the meeting was comparatively small; while many leading scientists took part in the discussions, and brought important problems before the sections, thus inducing many of the most able students to co-operate in their solution.

Section B (Physics) did very good work in discussing fully the report of the committee on the teaching of physics. Section A (Mathematics) joined on the first day in these discussions, and did not hold any meeting in its own hall. The report of the committee was made by Prof. T. C. Mendenhall. In substance it is as follows: —

The publication in the English language within a few years, of several excellent text-books of physics and a few laboratory guides of a high order of merit, together with a considerable advance in real scholarship among teachers, makes it possible to use the phrases 'text-book work,' 'lecture-work,' and 'laboratory practice,' with a fair chance of being understood; yet it may be well to remark, that, where the latter is referred to, something very different from mere illustrative experimentation is meant; it being the opinion of the committee that the work in the laboratory should be quantitative rather than qualitative, and always of as high a degree of precision as is possible with the appliances available.

In order to give definiteness to its conclusions, the committee undertook to answer the following questions: —

1. In what grade of the public school should physics-teaching begin? 2. What should be the character of this first instruction, — oral, by text-book, by laboratory methods, etc.? 3. What should be the character of the physics-teaching in the high school, — text-book, laboratory, text-book followed by laboratory, laboratory followed by text-book, or laboratory and text-book combined? 4. What knowledge of physics should be required for admission to college? 5. What should be the minimum course in physics for undergraduate students, and what should be the nature of this course?

The answers are as follows: —

1. In answer to the first question, it is the opinion of the committee that instructions in physics may begin, with profit, in what is generally known as the 'grammar school.' At the same time it is decidedly opposed to any general recommendation that it must begin there or in the primary school. Here, perhaps more than anywhere else, nearly every thing depends upon the teacher. One who has a strong liking for and a good knowledge of physics will be tolerably certain to succeed, while another not thus equipped for the work is equally certain to fail.

2. When taught in the grammar school and by a competent teacher, it should be done mainly by and through illustrative experiments. These may be of the simplest character, involving and exhibiting some of the fundamental principles of science; and they should generally be made by the teacher, the pupils being encouraged to repeat, to vary, and to extend.

3. In any discussion of the character of instruction in physics in the high school, one fact of the utmost importance must not be lost sight of. It is that a large majority of the young people who are educated in the public schools receive their final scholastic training in the high school. Its course of study must be in harmony with this fact, such provision as may be made for those who continue their studies in college or university being merely incidental. It is important that the student should be made acquainted, if only to a limited extent, with the methods of physical investigation, and that he should be able himself to plan and carry out an attack upon some of the simpler problems of the science. It is believed that the two very desirable ends can be reached without giving an undue share of the time and energy of the pupil to the subject. Assuming the high-school course to consist of four years of three terms each, it is recommended that the study of physics should begin not earlier than the third year; that it should continue through one year, three hours a week being devoted to it, not including the time necessary for the preparation of the lesson; and that during the first two terms the work should be text-book work, accompanied by illustrative experiments performed by the instructor, and made as complete as his facilities will allow, while the last term should be devoted to simple laboratory exercises.

4. As to the requirements in physics for admission to college, it is sufficient to say that the course indicated above should be required for admission to any and all courses in the college.

5. In reference to the minimum course in physics for undergraduate students in the college, it seems important to avoid the mistake of asking too much. In many institutions, and especially where the elective system largely prevails, it is possible at present for students to receive a degree and yet be almost absolutely ignorant of the principles of physics. It is the judgment of the committee that a knowledge of this subject constitutes one of the necessary and essential elements of a liberal education, and a minimum course of three hours per week for one year is recommended. What is usually known as the junior year is most desirable for this work, as at that time the student is sufficiently mature and has acquired the necessary training in mathematics to enable him to make the best of what he does. It is recommended that this course consist entirely of text-book and recitation work, with lectures fully and completely illustrated on the professor's table.

The report is signed by T. C. Mendenhall, William A. Anthony, H. S. Corbait, and F. H. Smith.

The very large attendance of members at the session when the report was read, and the continued discussions, show that the importance of the question at issue is well appreciated. The last day of the meeting was exclusively devoted to this subject. The report was very favorably received and unanimously indorsed. It was the opinion of the section that there should be a wide distribution of the report in the educational journals of the country.

The Physical Section did a considerable amount of valuable work besides that of the committee. On the first day W. LeConte Stevens read a very interesting paper on 'The Quality of Musical Sounds.' It contained a sketch giving the method adopted by Helmholtz in his investigation on musical quality, which resulted in the conclusion that "differences in musical quality of tone depend solely on the presence and strength of partial tones, and in no respect on the differences of phase under which these partial tones enter into composition."

In a paper on the 'Beats of Imperfect Harmonies,' read in 1878 before the Royal Society of Edinburgh, Sir William Thomson expressed conclusions inconsistent with those previously reached by Helmholtz, and the question was subsequently studied by means of the wave siren, invented by Rudolph Koenig of Paris, for the purpose of testing the effect of change of phase in quality of tone. This instrument was brought to America a few years ago, but was injured in transit so that it could not be operated. It has since been further improved. Mr. Stevens has had an opportunity to test its action in company with M. Koenig, and believes that through the instrument the truth has been established that variation in phase among the components of a composed sound is a distinct element in determining musical quality.

Dr. E. P. Howland described the most recent methods of instantaneous photography, and during his lecture showed a very interesting specimen of such work, — the photograph of a mule whose head had just been blown off with dynamite. It was taken before the animal fell. The paper was illustrated by experiments and projections.

E. L. Nichols and W. S. Franklin reported on some of their recent experiments on the direction and velocity of the electric current. A coil of wire of 390 turns was driven at a very high rate of speed, the axis of the coil being the axis of rotation. When the coil reached 338 revolutions per second, the linear velocity of the wire in the direction of its own length amounted to 8,000 centimetres per second. By means of two brush contacts at the axis, a current was sent through the coil while the latter was in motion. The magnetic moment of the coil was determined by means of a very sensitive astatic pair of magnets carrying a mirror.

Readings were taken with the coil at rest and in revolution, the motion of the coil and the direction of the current being repeatedly reversed. If the electric current result from the flow of a fluid through the wire, in other words, if it may be considered as possessing direction and finite velocity, the influence of a motion of the conductor with or against the current should produce an appre-

ciable influence upon the deflection of the magnet-needle, even though the velocity of the current were very large as compared with that of the conductor. In order to render the detection of this presumably very small effect less difficult, the direct influence of the coil was eliminated by differential winding. Under these circumstances, when the coil was carrying as large a current as it could be made to do without injurious heating, the rotation of the coil was found to be without appreciable effect upon the magnetic moment of the same. The best results were obtained by sending 4.6 ampères of alternating current of 40,000 alternations per minute through the coil.

At a velocity of the wire equal to 8,000 centimetres per second, they produced no effect upon the needle amounting to 0.2 millimetre deflection. The figure of merit of the coil and needle was determined by substituting a coil of continuous winding, its position with respect to the needle being the same as that of the rotating coil, and determining the current necessary to produce one centimetre deflection. The sensitiveness of the apparatus was found to be such that a current having direction and a velocity of 1,000,000,000 metres per second would have shown a change in its action upon the needle (when the motion of the coil was 380 revolutions, 8,000 centimetres per second) amounting to 0.1 centimetre deflection, — an effect which could not have escaped observation. It follows from the above negative result, that, if the electric current consists in the flow of a medium or fluid through the conductor, the velocity of the same must be greater than the exceedingly high rate just mentioned. Fopl, who in some recent experiments used an apparatus in most essential particulars similar to their own, but one by means of which only relatively very low velocities could have been detected, has reached the same negative conclusion.

Monday was almost exclusively devoted to electrical matters, while only few papers on the subject were read on the preceding days. While the interest of the section was concentrated in theoretical questions, a few problems of practical import were discussed. A new form of electro-magnetic telephone was described by R. B. Fulton, and the efficiency of incandescent lamps was treated by E. Merritt. Messrs. E. L. Nichols and W. S. Franklin gave the interesting results of their spectro-photometric comparison of sources of artificial illumination, which have an eminently practical bearing. C. J. H. Woodbury discussed the protection of watches against magnetism, — a problem that has become of importance since the increased use of electricity for industrial purposes.

The programme of the Mathematical Section embraced many problems of geophysics and astronomy, as well as discussions on the theory of physical instruments. Among twenty-one papers read, six were purely mathematical, while the greater number of the rest referred to astronomy. One of the most interesting of the latter class was Prof. A. Hall's paper on 'The Appearance of Mars in June, 1888.' It will be remembered that recently remarkable changes in its surface were observed which it is difficult to account for. Professor Hall has recently paid considerable attention to this subject, and has observed the planet on eighteen nights, from June 1 to July 2 inclusive.

While observing satellites in April, attempts were made on several nights to see the canals of Mars, but without success; and Professor Hall determined to make the trial in twilight, when he had been able to see more detail on the surface of planets. However, he was not able to see any thing like the regular canals drawn by European observers, although the usual reddish and dark spots and markings were visible nearly every night. The only remarkable change which he noticed during June was the diminution in the size of the white spot at the south pole of the planet. On June 1 the spots at the poles were a good deal extended, but on July 2 the one at the south pole had become very small and round.

The color and brightness of the sky, and the methods of exact measurements, were treated in the Mathematical and Physical Sections. While in the latter Prof. F. P. Whitman reported on certain photographic experiments, in the former Henry M. Parkhurst of New York City read a paper upon 'The Effect of the Brightness of the Sky in extinguishing the Light of Stars' with special reference to photometric observations with a wedge of neutral-tint glass. The presence of moonlight, of twilight, and even of ordinary starlight, diminishes the effect of the wedge according to the aperture of the telescope and the magnifying-power employed. By observations during the day he had ascertained that the effect of the wedge in extinguishing stars was reduced to less than one-tenth what it was in the evening. He also presented formulæ by which the effective value of the wedge can be ascertained under different degrees of illumination.

In the Chemical Section a report of the committee on water-analysis was read, from which we learn, that, so far, the propositions of the committee have not met with much encouragement in England. The question of water and water-supply was treated by Albert W. Smith with special reference to Cleveland and the water of Lake Erie, while E. H. S. Bailey spoke on the significance of the presence of ammonia in water. Prof. Frank H. Morgan of Cornell University also discussed the progress in chemical methods of water-analysis, and gave a preliminary notice upon iodine as a re-agent in the analysis of drinking-water. The last day of the meeting was devoted to the presentation and discussion of laboratory methods.

On account of the absence of the vice-president, Prof. C. M. Woodward of St. Louis, Section D (Mechanical Science) did not organize until the second day of the meeting, and work was not begun until the third day. Lieutenant Peary's paper, on 'Surveys for the Nicaragua Canal,' is mentioned below. In connection with this may be mentioned W. Nelson's paper on 'The Panama Canal,' which was illustrated by stereopticon views. As these subjects are pretty well kept before the eyes of the public, we refrain from a detailed report on the papers.

Considerable interest was excited by W. J. Keep's, C. F. Mabery's, and L. D. Vorce's statement on the influence of aluminium upon cast iron, in which it was shown that the addition of aluminium materially increases the strength of iron, that it causes the carbon to be changed from the combined to the graphitic state, and secures many other advantages.

If we turn to the proceedings of Section E (Geology and Geography, or, more properly Geology, as no geographical papers were read), we find ourselves somewhat embarrassed by the great number of valuable papers that were presented, and by the important facts and theories contained in many of them. We can therefore do no more than point out a few of the most important features of these lectures. Geologists from numerous States were present; but, Cleveland being situated on the Great Lakes, the theory of their origin and the glacial period in general chiefly attracted the attention of the meeting. This was principally the case on Friday, when J. W. Spencer read his interesting series of papers on 'Lake Warren and its Later History.'

Lake Warren is the first chapter in the history of the Great Lakes, and is subsequent to the deposit of the upper bowlder clay, and therefore the lakes are all very new in point of geological time. By the movements of the warpings of the earth's crust, as shown in the beaches, — after the deposit of the later bowlder clay, — the lake region was reduced to sea-level, and there were no Canadian highlands northward of the Great Lakes. Upon the subsequent elevations of the continent, beaches were made around the rising islands. With the rising of the land, barriers were brought up about this lake region, producing Lake Warren, — a name given to the sheet of water covering the basin of all the Great Lakes. A succession of beaches of this lake have been partially worked out in Canada, Michigan, Ohio, Pennsylvania, and New York, covering almost thousands of miles. Everywhere the differential uplift has increased from almost zero about the western end of the Erie basin, to three, five, and in the higher beaches to from five to nine, feet per mile. With the successive elevations of the land, this lake became dismembered, and the present lakes had their birth. The idea that these beaches in Ohio and Michigan were held in by glacial dams to the northward is disproven by the occurrence of open water and beaches to the north, which belong to the same series, and by the fact that outlets existed where placid dams are required.

With the continental rise described above, owing to the land rising more rapidly to the north-east, Lake Warren became dismembered, and Huron, Michigan, and Superior formed one lake; the Erie really was lifted out of the bed of Lake Warren, and be-

came drained; and Ontario remained at a lower level. The outlet of this lake was south-east of Georgian Bay by way of the Trent valley into Lake Ontario at about sixty miles west of the present outlet of this lake. The waters of this upper lake were twenty-six feet over this outlet into the Trent valley, and long continued to flow through a channel from one to two miles wide; and it has cut across a drift ridge to a depth of five hundred feet, as the whole area has been rising. With the continued continental uplift to the north-east (which has raised the old beach at the outlet about three hundred feet above the present surface of Lake Huron), the waters were backed southward, and overflowed into the Michigan basin and into the Erie, thus making the Erie outlet of the upper lakes to be of recent date. This is proven by the fact that the Georgian beach, which marked the old surface plain of the upper great lake, descends to the present water-level at the southern end of Lake Huron, and is beneath the surface of the water upon its north-western side, as the uplift, which has been measured, was to the north-east.

The Erie basin is very shallow, and, upon the dismemberment of Lake Warren, was drained by the newly constructed Niagara River. Subsequently the north-eastward warping eventually lifted up the rocky outlet, and formed Erie into a lake in recent times, thus making it the youngest of all the lakes.

Previous investigations have shown that there was a former river draining the Erie basin, and flowing into the extreme western end of Lake Ontario, and thence to the east of Oswego, but no further traceable, as the lake-bottom rose to the north-east. Upon the southern side there were a series of escarpments, some of which are now submerged. By recent studies of the elevated beaches, it is demonstrated that the disappearance of this valley is due to subsequent warpings of the earth's crust, and that the valley of the St. Lawrence was one with that of Lake Ontario. Recent discoveries show that the ancient St. Lawrence, during the period of high continental elevation, rose in Lake Michigan, flowed across Lake Huron and down Georgian Bay, and a drift filled the channel to Lake Ontario, thence by the present water to the sea, receiving on its way the ancient drainage of the Erie basin and other valleys.

The Huron and Ontario basins are thus sections of the former great St. Lawrence valley, which was bounded, especially upon the southern side, by high and precipitous escarpments, some of which are submerged. But upon their northern sides there are also lesser vertical escarpments, now submerged, with walls facing the old valley. The valley was excavated when the continent was at high altitude, for the eastern portion stood at least two hundred feet higher than at present, as shown by the channels in the lower St. Lawrence, in Hudson Strait, and in the New York and Chesapeake Bays. The valley was obstructed in part by drift, and in part by a north and north-eastward differential elevation of the earth's surface, due to internal movements. The measurable amount of warping defied investigation until recently, but now it is measured by the amount of uplift of beaches and sea-cliffs. Only one other explanation of the origin of the basins has been given, — the "erosion by glaciers." The foundation of this theory is that the glaciers are considered (by some) to erode. A theory of this kind was a necessity, so long as the terrestrial warping was not known.

Living glaciers, however, abrade but do not erode hard rocks; and both modern and extinct glaciers are known to have flowed over even loose morasses and gravels. Again, even although glaciers were capable of great ploughing action, they did not affect the lake valleys, as the glaciation of the surface rocks shows the movement to have been at angles (from 15° to 90°) to the direction of the side of the vertical escarpments against which the movement occurred; also the vertical faces of the escarpments are not smoothed off as are the faces of Alpine valleys, down which glaciers have passed. Lastly, the warping of the earth's surface in the lake region since the beach episode after the deposit of the drift proper is sufficient to account for all rocky barriers which may obstruct the basins.

These papers were followed by an interesting discussion, in which many prominent geologists took part.

A considerable number of papers treated of phenomena similar to those referred to in Mr. Spencer's papers, particular attention being paid to the study of ancient river-beds. A study of wide scope was A. Winchell's report on systematic results of a field-study of the archæan rocks of the North-west. It is not yet agreed what main divisions of the archæan should be recognized, nor whether any divisions exist in nature. The author's study in the region north-west of Lake Superior showed that this region is peculiarly adapted to the working-out of the order of succession of the various formations. He discovered certain stratigraphic discordances which indicate that the archaic rocks embrace three geological systems, which he designates as the equivalent to the Huronian, the Marquettian, and the equivalent to the Laurentian.

Prof. J. S. Newberry reported on the oil-field of Colorado, while E. Orton described recently discovered sources of oil and gas in Ohio, Indiana, and Kentucky. We merely mention the interesting paleontological papers by Professors Newberry and Ward.

Mr. J. T. B. Ives exhibited one of his interesting geological maps in the section, which consists of a series of colored pasteboards, each representing a geological system. The most recent rocks form the highest layer. Wherever they do not exist, the pasteboard is cut out; and the deeper layers, which represent the more ancient formations, are exposed to view, as they are on the earth's surface. By this effective system the distribution of rocks is very clearly shown. The only objection to such a map is, that those regions which are highest in nature appear to be lowest on the map.

We turn with some reluctance from the proceedings of this section, as so much that is of more than passing interest remains that has not been mentioned in these brief remarks.

While the meetings of Section F were not as good as in recent years, those of the Section of Anthropology showed a marked advance; the number of papers handed in being more than sufficient to secure a full programme, and their value being almost without exception very high. The culminating point of the meetings of this section was the discussion following Dr. Brinton's paper on 'The Alleged Mongolian Affinities of the American Race,' in which Major J. W. Powell, Prof. Horatio Hale, Prof. Otis T. Mason, and Prof. Frank Baker took part. Dr. Brinton gave a terse review of the arguments advanced in favor of the theory of the unity of the American and Mongolian races, and tried to refute them one by one. The discussion turned very soon to the question of races and the principles of classification. Major Powell upheld his frequently expressed views, that language is the only means of classifying peoples, although it also is imperfect. He rejected altogether any division founded on physical characteristics found in the relative proportions and in the peculiarities of the parts of the body, on the ground that every attempt in this line has failed. Prof. Horatio Hale agreed with Major Powell in that respect, that he also considered language the fundamental principle of classification. After Frank Baker had defended the methods based on the physical characteristics of peoples, Otis T. Mason was the first to make the discussion clearer by separating the points of view, which had so far been treated promiscuously, — the linguistic and the genealogical standpoints, or, as Dr. Brinton formulated it later on, the historical and genealogical standpoints. While the study of the former is well advanced in North America, the importance of the latter has hardly yet been fully recognized. The interesting discussion, the salient features of which we have here recorded, will, it is hoped, lead to an increased interest in the study of the physical characteristics of the American race.

Dr. Brinton read two papers more, which were as suggestive, and excited as much interest, as the former. He reported on 'Early Man in Spain,' and availed himself of this opportunity to throw open to discussion the question of an early North Atlantic connection between Europe and America, which was taken up by Thomas Wilson. The second paper was on 'Traits of Primitive Speech,' in which the author maintained that interchanging phonetic elements is a characteristic of such languages, and in which he concurred with C. Abel's theory of a root having the meaning of a certain idea, and of its negation at the same time. Unfortunately the limited time at the disposal of the section did not permit this suggestive paper to be adequately discussed. The basis of the inquiry was one that ought to be kept in mind by all philologists. He maintained that when inquiring into the origin of language we ought to know whether there is any language that can claim to be

more primitive than another, and thus he was led to the question, 'What are the characteristics of primitive language?' His conclusions may or may not be correct. It is of great importance to have emphasized the necessity of solving this preliminary question.

Another fundamental problem was brought before the section by Horatio Hale. Since the European origin of the Aryan race has been maintained by many authors, the champions of the old doctrine of their Asiatic origin have taken a firm stand, and looked for new arguments to defend their position. Max Müller's 'Biographies of Words' was written for this purpose, and Professor Hale seconded his friend in his paper 'The Aryan Race, its Origin and Character.' His main argument is that the race must have sprung from one household, that, according to his theory of the origin of language, must have lived in a favorable climate. Its language was originally complex and highly inflected, but in course of time, by mixture of races, became more simple in form. By this mixture he explains the numerous languages and various races of Europe. Next he dwelt upon the character of the original Aryan or his descendants. He believed that the Iranians were pure Aryans, and showed that certain of their traits may be discovered in European races, while others he ascribes to the aborigines they conquered. The paper was listened to with much interest, but did not excite as much discussion as might have been expected.

Horatio Hale's second paper, 'On an International Language,' engrossed at once the attention of the large audience that listened to it. He took up the argument of the American Philosophical Society, and indorsed its action in discussing the value of existing international languages and of the requisites of such a language. He showed the insufficiency of Volapük; and, in consequence of this interesting paper, a motion was brought before the council of the association, and adopted in the concluding meeting, to this effect: —

"Resolved, That, in the event of a congress being convened for considering the subject of an international language for scientific and other purposes, the council be authorized to appoint three members of this association as delegates, with two others as substitutes, to attend, at their own expense, the congress on behalf of the association, it being understood that no decision of the congress shall be binding on the association until it has been accepted in general session."

The committee appointed by the chair consists of Prof. Horatio Hale, Mr. Henshaw, and Professor McFarland.

We will mention in this place that the committee to memorialize Congress for the preservation of archæologic remains upon the public domain made a voluminous report. It was agreed that it would be well if the following remains of early America could be preserved: Chaco Cañon, Cañon De Chelly, Cañon Del Muerto, and Walnut Cañon, the ruin on Fossil Creek, ruins in Mancas Cañon, the round towers situated on the flat valleys of the lower Mancas, and the Cavate Lodges in the cinder cone, about eight miles east of Flagstaff, A.T. The report continues: "Besides these groups of ruins and dwellings, there are isolated remains in the Territories of New Mexico, Arizona, and Utah, numbering over forty, which demand preservation; the pueblos which are not on treaty reservations or grants, and the old Mandan and Arickaree village on the Fort Berthold Indian reservation in Dakota, to be preserved when they cease to be inhabited by the Indians, also certain burial and village sites in Alaska."

The committee in charge of this work — Miss Alice C. Fletcher and Mrs. T. E. Stevenson — have caused a bill to be introduced in Congress providing for a reservation in New Mexico for the purpose of archæologic study.

The important question of paleolithic man in America, which C. C. Abbott had made the subject of his vice-presidential address, was ably treated by Thomas Wilson, who is so thoroughly acquainted with the paleolithic age of Europe and America.

Attractive features of the meetings of this section were Prof. F. W. Putnam's illustrated paper on the 'Serpent Mound,' and the work done there during the last year; Prof. Otis T. Mason's lecture on 'Woman's Share in Primitive Industry,' which was also illustrated by lantern projections; and Col. G. Mallery's report on 'Algonkin Pictographs.' Professor Putnam's energetic action in preserving the Serpent Mound has roused the citizens of Ohio out of their inactivity, and a short time since a committee of ladies has been formed in Cleveland to preserve the interesting remains on Fort Hill. Referring to this matter, the following resolution was passed by the association: —

"Resolved, That we heartily commend the effort of the ladies of the Western Reserve to secure Fort Hill to the people of Ohio; that we appreciate highly the importance of preserving to all time, in perfect condition, one of the wonderful remains of antiquity so fast disappearing, and recommend to the citizens of Ohio the work already begun at the Serpent Mound in that State by the citizens of Massachusetts."

Professor Mason tried to show that there are two branches of civilization, one belonging to each sex, — hunting and procuring food, that of man; arts and industries, that of woman. In a very instructive way he traced the influence of the latter in all branches of life. Colonel Mallery's former work in the line of the study of pictographs has won him so well-deserved renown, that all his communications bearing upon this subject are listened to with the greatest interest, as they must form the basis of all studies on the development of the art of writing.

Among ethnological and archæological subjects which were brought before the meeting of the society, we will mention the important finds of paleolithic implements by Hilborne T. Cresson; the interesting exhibit of a gold ornament from Columbia, and a jadeite tablet from Guatemala, by George F. Kunz; and Stephen D. Peet's papers, in which he once more recapitulated his views on the archæology of America.

In the Section of Biology the theory of evolution occupied a prominent place. The number of leading biologists present was, however, not very large, and consequently the meetings of the section came to an end on Monday. Dr. E. L. Sturtevant read a paper which dealt principally with the limitations of evolution as influenced by human control. He demonstrated, in the case of the dandelion, the variability of the wild species and the practical identity between the wild forms and cultivated varieties. Prof. N. L. Britton called the attention of the section to the discrepancies in biological nomenclature, and urged a method to secure uniformity.

The paper of Thomas Meehan, on 'Adaptation in the Honeysuckle and Insect Visitor,' excited considerable discussion among the members of the section. The views of the author on the dependence of cross-fertilization upon the adaptation of the plant to the insect were not shared generally by the other speakers.

Mr. Burrill contended that the general fact of mutual adaptation was thoroughly established, and that the adaptation to other insects than the honey-bee in the honeysuckle might exist. Creative design or evolutionary development might form a point of discussion.

It was doubted by Professor Riley whether observations upon plants outside of their native habitat could be adduced for proving or disproving the existence of adaptations between plants and insects, the latter likely existing only in the native habitat of the plant.

The botany of Michigan was the subject of several papers by W. J. Beal, who gave a report on very interesting observations on the succession of forests in northern Michigan, and compared the flora of the east and west sides of that State, showing that the west side contained plants of more southern distribution, while the east side showed many northern plants not found on the west side.

The Botanical Club met formally on Wednesday morning, Judge David F. Day presiding, and the Rev. W. M. Beauchamp acting as secretary in Prof. V. Spaulding's absence. Judge Day's address included a memorial of the lamented Asa Gray, and a committee was appointed to draft resolutions on this. Steps were also taken for preserving and publishing the proceedings. It was found inexpedient to change the club into a section. On Friday the following resolutions on Prof. Asa Gray were adopted by a rising vote: —

"Resolved, That the Botanical Club of the American Association for the Advancement of Science sincerely regrets, that, meeting but once a year, it should be among the last of similar associations to place on record its sense of the great loss which the whole range of science suffers by the death of Prof. Asa Gray.

"Resolved, That, though among the last to contribute to the wreath of sorrow with which science is everywhere crowning the memory of Dr. Gray, this body takes a mournful pride in remembering that he was one of its honored members, and that it was as

a botanist he won such eminent renown. We feel that we have a right to be among the chief mourners at his departure from the field of labor he loved so well, and in a special degree to unite in sympathy with the many thousands who miss him everywhere.

"Resolved, That copies of these resolutions be forwarded to the family of our deceased friend, and given to the botanical and other scientific serials for publication."

Mr. S. M. Tracy read an interesting paper by Prof. George Vasey, which was finely illustrated by lantern-slides of the vegetation of the great American desert. A pleasant botanical excursion occupied the afternoon.

Prof. T. J. Burrill of Champaign, Ill., was elected president for the next meeting; B. D. Holsted of Ames, Io., vice-president; and D. H. Campbell of Detroit, Mich., secretary.

The report of the committee on the Botanical Exchange Club was accepted, with the thanks of the club for the valuable work accomplished.

The papers throughout the sessions were both valuable and interesting. Prof. J. F. James presented specimens of remarkable variations in *Dentoria multifida* and *Asclepias tuberosa*. Prof. F. L. Scribner's 'Observations on Nomenclature' brought up the question of who shall have credit for a name. Prof. B. E. Fernow's subject, 'What is a Tree?' called forth lively discussion. The question has come to be of considerable importance to the United States Land Office. Rev. Dr. Beauchamp's paper on 'The Names given to Some Plants by the Onondagas,' was listened to with great interest.

The first paper in the Section for Economic Science was read by B. E. Fernow, and treated of the necessity of a forest administration in the United States, in which he called attention to the vast extent of American forests and the wasteful practices by which this valuable property is being destroyed. He estimated the annual loss to the amount of from ten to twenty million dollars. These forests are situated mainly on the western mountain-ranges, which supply the surrounding semi-arid plains with water for irrigation, necessary for the agricultural development of the soil. The equalizing influence of the forest-cover upon waterflow makes their preservation as continuous forests an absolute necessity. Mr. Fernow recommended that an administrative bureau be formed which should have exclusive charge of the timber-lands of the government. Mrs. Laura Talbot of Washington distinguished herself by bringing the subject of industrial education, which has lately excited so much interest, to the attention of the section. Her paper was a vigorous plea for the establishment of industrial schools for children who are now placed in public orphan-asylums and reformatory institutions. Mrs. Talbot denounced the present system of caring for the waifs of the great cities of the country, asserting that it was educating these unfortunates to idleness and crime. She favored manual training in connection with these industrial institutions, as well as farming in all its branches. In the discussion that followed, a number of well-known educators took part, who expressed themselves in favor of manual training in connection with these schools.

Professor Atkinson's valuable paper on 'The Use and Abuse of Statistics' elicited a spirited reply from Col. E. Daniels on the question of currency on which Atkinson had touched, maintaining that a strictly metallic currency would greatly benefit the country. Daniels, on the other hand, said that coined legal-tender money, whatever its material, is of precisely the same purchasing-power, whether of paper, gold, or silver. It will pay precisely the same amount of debt. Coins are nothing else than tools of exchange. They vary in price or exchangeable value according to the number of them offered in the market. Daniels set forth his favorite views more fully on another day, when reading a paper on 'Our Monetary System.'

Discussion in the same line followed Edward N. Ammidown's paper, 'Suggestions for Legislation on the Currency.' He summarized his views in the demand that financial legislation in the United States should aim to increase the use for gold and silver money throughout the country, and to expand its volume in proportion to the growth of population and business. It should encourage the free issue of national bank currency under similar rules which now prevail to secure the easy and rapid expansion and contraction in harmony with the fluctuating requirements of trade. Such a policy would give the country a broad, substantial basis of metallic legal tender, and, through the national bank currency, furnish the means to maintain easily that equilibrium between demand and supply of money which is essential to continuous national prosperity.

The question of gold and silver was also the subject of a paper by S. Dana Horton, which was read on Monday, in which he considered the opinion established that parity of metals can be maintained by concurrent laws of nations. The question is only a political one whether the European nations will pass these laws.

E. Atkinson's paper, which was mentioned above, covered a wide range of facts. He dwelt upon the abuse of statistics in the separate comparisons of rates of wages and prices of goods, and emphasized the necessity of careful training in this branch of science in order to avoid false deductions and conclusions. His prime object was to show, that, unless statistics are made use of as a basis of economic reasoning by persons competently trained, they become a mere snare and pitfall, working more harm than good through the false deductions that may be made from them; while, on the other hand, the economist who attempts to reason on the condition of men in their relation to each other without regard to the statistics of prices, wages, volume of currency, and other elements by which the exchange of services is contrasted or measured, will, of necessity, be a mere theorist whose unsustained hypotheses may not come near the mark.

On the following day W. O. Atwater subjected the doctrine of Malthus, and his views on the food-supply of the future, to a critical study, and found that the prospects for a greatly increased supply by the use of the discoveries of modern science are very hopeful, and that we do not need to fear the ultimate starvation of mankind. Mr. Charles S. Hill, in his paper on 'Ship-Building and Shipping,' reviewed the history of the decline of American shipping. He vigorously denounced the action of Congress in withdrawing that national aid from American shipping which enabled it to compete with the British. He demanded that ship-building and shipping should be revived in this country by all possible means, and showed how many industries and trades would thus receive a new impulse. The most important paper of this day was a report on the progress made in the work of surveying the Nicaragua Canal route. It will be remembered that at the New York meeting a general sketch of the work done up to that date was given, and the Nicaragua Canal Association did not lose its opportunity at the present meeting of again calling the attention of the public to its enterprise. A photographic reproduction of a bird's-eye view of Nicaragua, and a map (on Mercator's projection) showing the routes around Cape Horn and through the projected canal, were exhibited. Commander Taylor's general report on this subject went materially over the same ground as many of his former lectures on the same subject, but he added a report of the proceedings of the association during the past year. He stated that the contract of 1887 with the republic of Nicaragua had been supplemented recently by one of similar tenor with Costa Rica, perfecting the exclusive title of the Canal Association. A bill to incorporate the Maritime Canal Company of Nicaragua has passed the United States Senate, and now awaits action by the House of Representatives, having been favorably reported by its committee on commerce, with the expression of the committee's full satisfaction as to the financial standing of the Canal Association. Next, Lieut. R. S. Peary gave a sketch of the history of surveys, and of the work done during the present spring. The methods of work were as follows: The expedition being divided into parties and the work into sections, the locations of 1880 in the western division, and of 1872–73 and 1885 in the eastern, were taken as bases, and a main transit and level line run, and bench-marks established about every thousand or two thousand feet. These benches were then checked. From this transit-line, compass, chain, and aneroid offsets were run from one thousand to two thousand feet on both sides; adjacent streams, valleys, and hills reconnoitred; and the work plotted. With this chart in hand, the entire line was then gone over in the field by the engineer in charge, accompanied by the chief of the section, and the location decided upon. The location was then run in and levelled, checking upon the benches of the preliminary line, and cross-sections run and levelled from one hundred to four hundred feet apart, along the

main line, as the topography demanded. Sometimes portions of this location were modified and re-run. Streams were then surveyed and gauged, neighboring elevations beyond the limits of the canal taken with the aneroid, and the entire work plotted on a four-hundred-foot scale with a ten-foot contour. The boring party then went over the line, boring on all summits and in all depressions, and penetrating to the level of the canal-bottom unless rock was encountered sooner. Borings were also made on the sites of all locks, dams, and embankments.

Two perfectly practicable routes of about equal cost were found, either of which is far superior to any other route across the isthmus; and when the day comes, as it surely will, when one canal cannot accommodate the traffic seeking it, then the other can be built, and give one canal for eastward and one for westward bound vessels. The computations of the notes of the surveys being yet incomplete, precise quantities and estimates cannot now be given. In general terms the quantities in the sections where no modifications are made will be the same as those of 1885, while the saving from modifications will be from ten million to fifteen million dollars. The item of earth excavation, with its varied plant of excavators, cars, locomotives, etc., and its attendant expense of maintaining and shifting tracks and handling material in rainy weather, is reduced to a minimum, and the construction of the canal provided for practically under the three heads of hydraulic mining, rock-excavation, and dredging, all independent of drainage and rains. The work can be prosecuted day and night without interruption. Numerous borings have made an end of the bottomless swamps, semi-liquid quicksands, and numerous other subterranean bugbears which have been conjured up against this route, and have shown that in no portion of either line is there any trouble about foundations. In the worst swamps the boring implement, after sinking with its own weight perhaps ten or at most fifteen feet, reached a stratum of firm red clay extending to bed-rock. The experience of the expedition is worth volumes as evidence concerning the effects of the climate of Nicaragua. During the seven months it was in the field, not a man out of nearly two hundred was lost, and there was not a single case of serious illness. The size and capacity of the canal will not vary materially from the plans of 1885. The number of locks will be reduced to six, and possibly five, and the time of lockage to thirty minutes. The general dimensions and methods of construction of the locks are not changed, but the double lock at La Flor is a new feature.

C. K. Remington's plea for cremation was very much contested by various members of the section. The paper was illustrated with diagrams on the blackboard, and the process of incinerating a body was fully explained. The description of the construction of a crematory was especially interesting. In answer to questions propounded, Mr. Remington stated that cremation was necessary as a sanitary measure. He also contended that the land used for cemeteries was needed. He thought it much better that a body should be reduced to dust in an hour than for it to lie in the ground for years.

Mr. Henry Farquhar gave, under the title 'Economic Value of Binary Arithmetic,' a paper that was more interesting from a theoretical point of view than from a practical. He explained the advantages that would accrue from the substitution of two for ten as a basis for counting. Instead of having to commit sums of figures to memory, we would perform addition by simply counting the marks of similar shape. There would be no multiplication table to learn, all multiplication being resolved into displacement of symbols on a regular plan. This would bring a considerable degree of arithmetical skill within reach of many who cannot possibly attain it at present.

On Tuesday J. R. Dodge read an interesting paper on 'The Agricultural Surplus.' He pointed out that the United States have a surplus of agricultural products very large in proportion to the total volume. He considered this fact an element of strength and of weakness, and at the same time a subject of congratulation and regret. "The congratulation," he said, "is found in the ability to relieve the deficiencies of needy nations, while swelling the plethora of domestic wealth: the regret is for the tendency to over-production of certain crops, and its inevitable result. This is the reduction of prices for the benefit of the foreign purchaser, without any advantage to the producer. Very few people know the extent of our net surplus in agriculture. Almost every one exaggerates it." Mr. Dodge continued to show that the value of the exported product at farm prices is less than $400,000,000. The value of the deficiency supplied by import very nearly reaches $350,000,000. Thus we have a surplus sufficient to pay for our deficiency, and little more. This is the net result of our boast of feeding the nations. We feed them just a little more than they feed us. The lesson we learn from these facts is, that no nation can afford to have a deficiency of the raw products of agriculture; and, as a rule, nations do not. There is one notable exception, and that is apparent more than real. Great Britain seems to have a large deficiency. Really it is largely made good by shipments from her own colonies, of the dividends of her own capital, under the technical name of 'imports.' Our agriculture, therefore, should seek to supply deficiencies rather than to swell surplus crops; to meet the present wants of domestic markets, and create new wants by a greater variety of edible products, especially the fruits; and afterwards supply any deficiency of foreign nations that is practicable or possible.

Last of all we mention W. F. Switzler's sketch of the history of statistics, in which he showed that at the earliest stages of civilization attempts to ascertain statistical data were made, and in which he traced the gradual development of that science. He dwelt upon the importance of statistics to the statesman, whose art is thus made "to rest on the solid masonry of well attested and accomplished facts, the granite pedestal of recorded history. It is no longer a speculation: it has become a mathematical demonstration. It is no longer a prophecy: it is a revelation." The paper closed with an interesting history of the methods of gathering statistical data.

The meetings of this section were well attended, and there was sufficient material on hand to keep the section busy until the end of the meeting.

EVIDENCES OF THE ANTIQUITY OF MAN IN EASTERN NORTH AMERICA.[1]

IN studying the history of man we have to adopt the same methods and draw the same inferences as have been done in tracing the evolution of animals. This, strangely enough, seems repugnant to very many, who feel that any relationship, however remote, with less intelligent creatures, is a reflection upon their own intelligence.

To determine at what precise point in geological time man appeared upon the earth, is, it seems to me, obviously impracticable, from the fact that the dividing-line separating humanity from the non-human cannot be drawn. It were as easy to name the moment when the gloaming merges into night, or shout with confidence, 'Now!' as the dawn brightens into day. Nor is it demonstrable, with our present knowledge, to point to that country where the momentous change first took place, if it occurred but once. At present, however, we can safely say that miocene man is extremely problematical, and pliocene man a question as yet unsettled; the auriferous gravels of California being pronounced late tertiary by Whitney, and by LeConte as representing "the beginning of the glacial epoch."

At all events, we have neolithic man as far back as the glacial epoch, and possibly in the pliocene. Man in the tertiaries, therefore, championed by my honored predecessor, Professor Morse, becomes something more tangible than a hypothetical creature. Professor Putnam has arrived at the conclusion that the western coast of our continent was inhabited by man in earlier geological times than the eastern half.

Mr. Warren Upham has examined the drift formation of Little Falls, Minn., where Miss Babbitt found those extremely rude but unquestionably worked quartzes, and describes it as the flood-plain of a river of the glacial epoch.

In 1883, as the result of exhaustive studies of glacial deposits, from New Jersey westward, across Ohio, Rev. G. Frederick Wright predicted that traces of paleolithic man would be found in the latter State.

[1] Abstract of an address before the Section of Anthropology of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15-22, 1888, by Charles C. Abbott, vice-president of the section.

Paleolithic implements, concerning which there can be no doubt, have not been discovered in abundance as yet, but Professor Wright's belief proves to have been well founded. Dr. C. L. Metz of Madisonville, O., has discovered two specimens which set the matter at rest. Both were found at significant depths, one of them nearly thirty feet below the surface. The region where found is one characterized by immense gravel-deposits of glacial age and origin.

They show that in Ohio, as well as on the Atlantic coast, man was an inhabitant before the close of the glacial period. We can henceforth speak with confidence of interglacial man in Ohio. It is facts like these which give archæological significance to the present fruitful inquiries concerning the date of the glacial epoch in North America.

Mr. Hilborne T. Cresson has discovered two chipped implements of argillite which he found *in situ*, at a depth of several feet from the surface, in railroad cuttings through the old terrace of the Delaware River near Claymont, Del. The geological position of these specimens will excite discussion, but their great age will not be questioned. Of particular interest, in relation to discoveries in the gravels at Trenton and Ohio, is the discovery of a large flint implement found by Mr. Cresson in the glacial gravel in Jackson County, Ind.

From evidence so far obtained, it seems that on either seaboard paleolithic man lived in great numbers, and that as a coast-dweller he pre-eminently flourished. In the valley of the Delaware River paleolithic man has left such abundant traces of his former presence, in the form of rudely fashioned stone implements, that for long they were considered as the hasty or unfinished work of the later Indians.

As the first to point out what is now maintained by competent archæologists to be their real significance, I may be pardoned for devoting the conclusion of my address to a consideration of that region, — the Delaware valley, — so far as its physical character and the traces of prehistoric man found there have a bearing on the question of the antiquity of man in America.

The question may now be asked, What is a paleolithic implement? It is not very readily defined, as there is considerable variation in the shape; but, as I understand the significance of the term, it is properly applied to coarsely chipped masses of flinty rock, upon which a distinctly designed cutting edge is formed, to which is often added an acute point. Furthermore, they show unmistakable evidence of antiquity by the weathering of their surfaces; and they are found as a rule, but not necessarily always, in deposits of glacial or river drift with which they agree in age.

How far do these Trentonian implements meet with these requirements?

My own impressions of their true character was not suddenly reached. The evidence of other kind, of the antiquity of the Indian, led me to consider them as rude objects made for some trivial purpose and discarded. Later, I became convinced that they were older than ordinary surface-found relics, and assumed that the Indian of history commenced his career in this valley while in the paleolithic stage of culture.

Thus, while pursuing my collecting of Indian relics, it was gradually forced upon my mind that these rude implements were more intimately associated with the gravel than with the surface of the ground and the relics of the Indians found upon it.

Acting upon this, I continued for two years to examine most carefully both the surface of our fields and every exposure of the underlying gravels; and in June, 1876, after having found several chipped implements *in situ*, expressed the opinion that the Delaware River, "now occupying a comparatively small and shallow channel, once flowed at an elevation of nearly fifty feet above its present level; and it was when such a mighty stream as this, that man first gazed upon its waters, and lost those rude weapons in its swift current, that now, in the beds of gravel which its floods have deposited, are alike the puzzle and delight of the archæologist. Had these first-comers, like the troglodytes of France, convenient caves to shelter them, doubtless we should have their better wrought implements of bone to tell more surely the story of their ancient sojourn here; but, wanting them, their history is not altogether lost, and in the rude weapons, now deeply embedded in the river's banks, we learn, at least, the fact of the presence, in the distant past, of an earlier people than the Indian."

Thus it will be seen that I have been fairly cautious in my statements, and slow in reaching any conclusions with reference to these implements which separated them from ordinary Indian relics.

But, admitting that a given class of stone implements is characteristic of a given deposit of gravel (and I think we must admit this now), what is the geological history of this deposit? Is it too recent to be of special import, or too ancient to be of archæological significance? Both views have been held, and neither proves tenable. That the former view should have found supporters is indeed strange. Certainly there is now no movement of the gravel by the river, whatever its condition or freshet stage; and certainly, if these rude forms were of identical origin with common Indian relics, then rude and elaborate alike — jasper, quartz, porphyry, and slate together; axes, spears, pottery, and ornaments, all of which are found upon the surface — should have gradually become commingled with the gravel, even to great depths. Any disturbance that would bury one would inhume alike the various forms of neolithic implements. Such, however, is not the case.

How old, and not how recent, are the Delaware valley, or, as they are now known, Trenton gravels? This, it is all-important, should be definitely determined. A clear light has been thrown upon these questions by G. F. Wright, who shows that these gravels are the last important result of the glacial epoch, the direct result of the melting of the glaciers, as they retired northward; and that, while this was in progress, the rude implements of paleolithic man were lost and embedded in them.

Admitting this, how long ago did it take place?

If we accept the most moderate estimate of the length of post-glacial time, some six thousand years, we have of interglacial time (i.e., between the first and second epochs) from eighteen thousand to sixty thousand years; and to this, as I understand the matter, must be added the long stretch of time during which the second epoch of cold continued. Assuming, therefore, that geologists have made no mistake, archæology has time enough and to spare. At no time was the continent uninhabitable, however thick and wide-reaching the ice, or deeply submerged the lower-lying areas. Still there was land enough for mammalian life in all its glory, and it flourished at the very foot of the advancing ice-sheet, and re-entered every tract as the glaciers withdrew. Then we had the mastodon and mammoth, reindeer and bison, musk-ox and moose, and man familiar with them all.

Having made clear, I trust, what is meant by paleolithic man, and shown also that he *was* a fact and *is* not a fancy, the question naturally arises, What was his fate? Did he, like the mastodon, become extinct, or has he descendants still living on this continent? If the paleolithic implements were strictly confined to the gravel-deposits, like fossils in the underlying marl-beds, then, as it seems to me, we would be unable to refer paleolithic man to any branch of the human race now alive; but, as a matter of fact, there is no such break, — no evidence of an hiatus of greater or less duration between paleolithic man and the Indian. The former continued to dwell here until the last pebble of the great gravel-deposit had been laid down, and possibly into the soil-making period, but not now, as paleolithic man. The significant advance to the manufacture of more specialized implements took place; the rude argillite paleolith, the same in form the world over, giving way to spears and other definite forms. The form of the product altered, but the same material, argillite, continued in use. There was no pottery, no polished stone, little if any attempt at ornamentation; still, when we compare these later objects of argillite with the earlier and original patterns, we see what a tremendous forward stride had been made.

Next we have to consider the important fact that the flint implements known as Indian relics belong to the superficial black soil, while at the base of this deposit of soil the argillite implements occur in greatest abundance.

This briefly covers the range of evidence, first, that paleolithic man did not become extinct; second, that his descendants attained to an advanced degree of culture in the land of their forefathers. What, then, was this people's subsequent career? Were it not for the three skulls found in the Trenton gravels, we could still main-

tain that we have their descendants in the Eskimo, and that they were finally driven north, after contact with the Indians, who, as is conceded by all students, migrated hither, at, archæologically considered, a not exceedingly remote period. The Indian traditions assert that they found the region occupied; and for once, at least, we have evidence which confirms tradition.

However others may be impressed by what I have now presented, for myself, as I wander along the pleasant shores of the Delaware River, seeing it but a meagre stream between high banks in midsummer, or in winter swollen and choked with ice until these are almost hidden, I recall what time this same stream was the mighty channel of glacial floods, pouring seaward from the mountains beyond, and picture the primitive hunter of that ancient time, armed with but a sharpened stone, in quest of unwary game. And later, when the floods had abated and the waters filled but the channel of to-day, I recall that more skilful folk who with spear and knife captured whatsoever creature their needs demanded, — the earlier and later chippers of argillite.

These pass; and the Indian, with his jasper, quartz, copper, and polished stone, looms up as the others fade away. His history, reaching forward almost to the present, I leave in the hands of others to record.

SCIENTIFIC NEWS IN WASHINGTON.

A Great Medical Meeting to be held in Washington.— Interesting to Mariners: a Simple Method of computing a Ship's Course and ascertaining her Distance sailed on the Great Circle between the Point of Departure and the Point of Destination, about to be published by the Hydrographic Office: a Valuable Set of Charts nearly completed. — Terrible Death Rates in India.

The First American Medical Congress.

THE first triennial meeting of the Congress of American Physicians and Surgeons will begin in Washington, Sept. 18, and will continue three days. Three years ago one of the societies constituting the congress conceived the idea of bringing together once in three years representatives of the great medical societies of the country. The plan was presented to all of them, and indorsed by ten. These eleven societies, in accordance with the general plan suggested, each appointed one of their number to constitute an executive committee. The committee met, and decided that an association should be formed with the name given above.

This committee is composed as follows, the names of the societies they represent being appended: C. M. Martin, Mobile, American Surgical Association; John P. Bryson, St. Louis, Genito-Urinary Surgeons; J. Solis Cohen, Philadelphia, American Laryngological Association; A. L. Loomis, New York, American Climatological Association; William Pepper, Philadelphia, Association of American Physicians; William H. Carmalt, New Haven, American Otological Society; William F. Norris, Philadelphia, American Ophthalmological Society; L. C. Gray, New York, American Neurological Association; J. E. Atkinson, Baltimore, American Dermatological Association; H. P. Bowditch, American Physiological Society; N. M. Shaffer, New York, American Orthopedic Association.

The committee also determined that a meeting should be held in this city once in three years: the September session will therefore be the first. It is also proposed that the several societies constituting the congress shall hold their annual meetings at the same time, each being conducted according to its own special programme. This will make the occasion one of the most important to the medical profession of the United States that has ever occurred. The separate societies will each hold meetings twice a day, while the meeting of the congress will take place on Tuesday, Wednesday, and Thursday evenings.

The topics for discussion at the three meetings of the congress will be as follows; on Tuesday evening, 'Intestinal Obstruction in its Medical and Surgical Relations' (Drs. R. H. Fitz of Boston, and Nicholas Semm of Milwaukee, will open the discussion, and they will be followed by others whom the executive committee may designate); on Wednesday, 'Cerebral Localization in its Practical Relations' (Dr. Charles H. Mills of Philadelphia, and Dr. Roswell Park of Buffalo, will open the discussion, and they will be followed by Mr. Victor Horsley and Professor Ferrier, of London, Eng.); on Thursday evening the congress will meet in the hall of the National Museum, and Dr. John S. Billings, U.S.A., of Washington, president of the congress, will deliver an address on 'Medical Museums.' At the close of this session a reception will be given in the Army Medical Museum building, to which members and invited guests, their wives and daughters, will be invited.

In addition to the reception on Thursday evening, a complimentary dinner will be given to the guests of the congress by the members, on Monday evening, at Willard's Hotel. Some of these invited guests are as follows: Sir Spencer Wells; Sir Andrew Clark; Sir William McCormac; Drs. W. O. Priestly, William Ord, and Grainger Stewart; Mr. Lawson Lait; Mr. Victor Horsley; Mr. Thomas Bryant; Mr. Thomas Annandale; Professors Ferrier, Esmarch, and Gerhardt; Drs. Rafael Lavista of Mexico, J. L. Reverdin of Geneva, O. W. Holmes and H. J. Bowditch of Boston, Joseph Leidy of Philadelphia, W. Kingston and Eccles of Canada.

An informal collation will also be served at Willard's Hotel from ten to twelve o'clock Tuesday evening, to which only members of the congress, and other physicians who may be in the city, will be invited. The following-named gentlemen compose the committee of arrangements for the meeting: Samuel C. Busey (chairman), J. Ford Thompson, R. T. Edes, E. C. Morgan, W. W. Johnston, and S. O. Richey, of Washington; J. E. Atkinson, H. Newell Martin, and Samuel Theobald, of Baltimore; A. Sydney Roberts of Philadelphia; and A. T. Cabot of Boston.

Neither the congress nor the individual societies will transact any business during the meeting. The object of the congress and of the several societies is the consideration of subjects pertaining to medical science. The discussion of medical ethics and kindred topics, even, is excluded. The congress will not even elect officers. Dr. Billings has been chosen by the executive committee to preside, and the presiding officer of the next congress will be selected by one of the societies represented in the congress. The object of the gathering may be more definitely stated to be to consider and discuss professional topics of a scientific nature, and nothing else will be brought to the attention of the members. The expenses of the congress will be paid by the members, whose contributions will all be voluntary. Headquarters for the registration of members will be opened at Willard's Hotel on the Saturday preceding. Dr. Busey expects that there will be an attendance of about five hundred members. Three other medical societies not connected with the congress will hold their annual sessions in Washington at the same time. They are the American Gynecological Society, the American Association of Obstetricians and Gynecologists, and the Pediatric Society.

'Recent Developments in Great-Circle Sailing.'

In view of the increasing recognition among mariners of the sound principle of conducting a ship along the arc of the great circle joining the points of departure and destination, and of the great advantages to be gained by a knowledge of this branch of nautical science, a work bearing the above title has been prepared in the Hydrographic Office, which has for its object the collection into one volume of all the analytical processes, and a description of all charts and devices which have been constructed, for the navigation of the great-circle track. It thus forms a history of the development of methods of great-circle navigation, and reveals the present state of the science, and is also a treatise on the subject, so arranged as to give a clear conception of each method, and to form a directory to sources where more extended information may be found.

The work presents the methods, among others, of Towsen, Airy, Chauvenet, Lieutenant Hilleret (French Navy), Commander C. D. Sigsbee, U.S.A., and Mr. Gustave Herrle of the United States Hydrographic Office. The latter method is undoubtedly the simplest yet found for practical use in great-circle sailing.

The simplicity of the methods necessary for navigating the really circuitous track of the Mercator projection, and the long duration of its usage, have so popularized them with seamen, that no method of handling charts dissimilar to them will be received with favor. Another essential consideration in the construction of great-circle sailing-charts is a method that enables one to measure the course and distance, from the actual position of the vessel, independently

of any great-circle track previously laid down, just as the rhumb course and distance are measured on the Mercator chart. These principles were recognized in the construction of the great-circle charts issued by the Hydrographic Office. The maturing of them, and their publication in the form of the present excellent sailing-charts, have been due to that office. They are now issued for the North and South Atlantic Oceans, and Indian Ocean. The plate for the latter was used to reproduce, by electrotyping, plates for the North and South Pacific Oceans. It is expected that this series of sailing-charts will be completed before July 1, 1889. Those already published have been received with great favor, and have undergone severe tests for accuracy and utility; and numerous reports have been received testifying to their usefulness in lessening the labor of computations on the great-circle route.

The general lack of the practical application of the principles of great-circle sailing in the past seems to have resulted, not from the want of recognition of the fact that the shortest distance between any two points on the earth's surface is the arc of the great circle passing through them, nor that the great-circle course is the only true course, but from the tedious operations which have been necessary, and from the want of concise methods for rendering these benefits readily available.

Sanitation in India.

Mr. B. F. Bonham, United States consul-general at Calcutta, has sent to the State Department an abstract of a lecture by Mr. Justice Cunningham, at the Parkes Museum, on 'Sanitation in India,' from which the following interesting extracts are made: —

"The views of the sanitary parties in India might be summarized in the following proportions: that the mortality of the population is vastly in excess of that of civilized countries, and in particular cannot be calculated at less than 10 to 15 per thousand in excess of the English rates, an excess making at least 2,500,000 of deaths and 50,000,000 cases of severe diseases; that this excess, or a large portion of it, is preventable by practical means fairly within human competence; that the existing administrative machinery is powerless to make any impression on this excessive mortality, but that its tendency is rather to intensify it; that there are reforms which materially affect it, which might be adopted without grievance to the people or detriment to the government finances, and that it is the duty of the government to adopt such reforms. As to the excessive mortality, the lecturer pointed out that wherever registration approached completeness there were high ratios of 30 per thousand and more, the central provinces ratio being 34 and the north-western provinces 32; that many large areas with populations of a million and upwards showed ratios of 40 and 50 per thousand, and many towns and municipalities showed ratios of 40, 60, 70, 80, and even higher. Such ratios showed that the laws of health were being contravened on an enormous scale. A curious instance of the extreme prevalence of disease was shown in Calcutta, where, out of a population of 445,000 persons, no less than 325,000 were treated annually in public medical institutions. Coming next to preventability, experience proved, that, wherever effective sanitation was carried out, the ratios of Indian mortality sunk at once to that of England.

"The great mass of Indian mortality was occasioned by epidemic diseases, which are preventable or mitigable, and in England have either disappeared or sunk to insignificant proportions. The Army Sanitary Commission gave what they call a 'deplorable record' of 38,000,000 of victims within a single decade to such diseases. Coming to particular instances, the extraordinary reduction in the mortality of the European army from 69 per thousand to 12 or 14, and the invaliding ratio from 43 to 23, the cholera mortality from 9.24 to 1.17, showed what sanitation could do in the case of men newly exposed to a tropical climate. The reduction of the mortality in jails was equally remarkable: it is now about one-third of the former rate. In Madras the extraordinarily low ratio of 17.80 per thousand had been attained. The high ratio of over 100 per thousand in some Bengal jails pointed to active insanitary conditions of soil, structure, or mismanagement. Another striking instance is that afforded by those parts of Calcutta which have been properly sanitated, which would compare favorably with the best parts of London for healthiness, while the insanitary wards of the city are scourged with epidemics, — are the perennial home of cholera, — and the suburbs of Calcutta have long been a scandal, not only to the Bengal Government, but to English civilization."

BOOK-REVIEWS.

A Text-Book of Physiology. By JOHN GRAY M'KENDRICK. Including Histology, by Philip Stöhr. In two volumes. Vol. I. General Physiology. New York, Macmillan. 8°. $4.

THE book before us, which is but the first volume of M'Kendrick's 'Text-Book of Physiology,' is modelled to some extent on his 'Outlines of Physiology,' although it has been so greatly extended in every direction as to make it an entirely new book. This volume treats of the general physiology of the tissues; while the second, not yet published, but in the printer's hands, deals with the special physiology of organs.

In the introductory section the author discusses the nature and objects of physiology, matter and energy, and the general principles of biology, including the organic form and mode of growth, the evolutional history of living beings, and the theories of life. In the second section the chemistry of the body is treated; the nature and properties of the chemical substances found in the body, and the nature of the chemical re-actions with which the phenomena of life are associated, being considered fully. The true value which should be given to chemical formulæ by the physiological student is specially explained by the author. The chapter on pigments is an exceedingly valuable one, the subject being treated more fully than in any other text-book of physiology.

Dr. M'Kendrick has been especially fortunate in being able to incorporate into his text-book Professor Stöhr's 'Lehrbuch der Histologie,' which, so far as we know, had not, up to this time, been translated. The illustrations of this portion of the work are not diagrams, but drawings of real preparations, and remarkably true to nature.

The closing section treats of the contractile tissues. In it the electrical apparatus employed in the study of muscle is described and illustrated. The author believes, and we think rightly, that the importance of the uses of electricity in practical medicine and surgery justifies him in describing electrical apparatus. We are somewhat surprised to find the statement that "the teacher has usually to deal with students who know little or nothing about physics." We had supposed that the student, before being permitted to begin the study of medicine in the United Kingdom, must be well prepared in physics, and are therefore surprised to hear one who is undoubtedly in a position to know, say that he knows "little or nothing" about it. It appears, however, from our author's preface, that an examination in mechanics is required as a preliminary; but this, he says, is of no use, being just sufficient to worry the student and exhaust his energies, without conferring any real benefit in the shape of a knowledge of the principles of physical science. It is on account of this ignorance on the part of students that certain details as to physics are introduced into this text-book. Taken as a whole, the first volume of Dr. M'Kendrick's book is a most valuable one, and we shall look for the second with great interest. If he succeeds as well in his treatment of special as he has succeeded with general physiology, his text-book will be entitled to a prominent place among the best text-books of physiology.

Electrical Instrument Making for Amateurs. By S. R. BOTTONE. 2d ed. New York, Van Nostrand. $1.20.

IN the preface to this work Mr. Bottone says, "Nearly all the really useful inventions and discoveries which have rendered the nineteenth century so remarkable as a season of progress must be attributed to amateurs. For this reason, if for no other, we should render every assistance in our power to the *bona fide* amateur." Mr. Bottone's idea of a *bona fide* amateur is difficult to conceive. He would claim a wide meaning for the word if he included Faraday, Maxwell, Joule, Thomson, and Rayleigh, in his own country. Still there is no need of quarrelling about a definition, or of asking by whom the useful work of this century has been done. Mr. Bottone's book is a helpful and a needed one, and has much to com-

mend it. It appeals to 'true amateurs,'— boys who have a scientific turn of mind, and men who have some leisure from their work, but who have not the facilities that a laboratory offers.

The tools required are of the simplest kind, no turning-lathe or expensive apparatus being needed. Most of them are to be found in the ordinary equipment of a householder: the rest may be purchased for a few dollars. The materials, too, are inexpensive and easy to get.

The directions in this book are full and clear, and where it is necessary dimensional drawings are given. When the amateur has built every thing that is described, he will find himself in possession of quite a complete set of apparatus for electrical experiments, — galvanometers, electroscope, condenser, voltmeter, Wimhurst machine, induction-coil, etc.; and, if he compares the cost of them with the catalogue prices, he will have cause to congratulate himself. But the most important thing he has acquired is a skill in manipulation, and a knowledge of the instruments that will enable him to experiment usefully with them.

There are some verbal errors in the book, — we do not usually speak of "8 *hours'* resistance," for example, — but they do not take away its usefulness. In that part of the appendix, however, that treats of accumulators, there is the serious mistake of confusing discharge-rate with storage-capacity. Page 174 had better be omitted.

Popular Chemistry. By J. DORMAN STEELE. New York, Barnes. 16°.

THIS is the familiar 'Fourteen Weeks in Chemistry,' revised and brought down to date, with some additions in appendices describing methods of manipulation and simple analyses. The object of this successful book was, by bringing out prominently such elementary facts in chemistry as would be likely to interest the average boy or girl, to give the most of them such a smattering of knowledge as would give a key to many of the chemical changes they would be likely to observe in every-day life, and to leave such a pleasant impression with the few as might lead them to further study. The book has served its purpose well in the past, and, in its new form, is likely to have a continued usefulness for some time to come. The revision has been done by competent hands. A useful glossary, giving the pronunciation of chemical terms, is one of the additions. The chapters on organic chemistry have been completely re-arranged and to a great extent re-written.

An Index to Engineering Periodicals, 1883 *to* 1887 *inclusive.* By FRANCIS E. GALLOUPE, M.E. Boston, 30 Kilby Street; New York, Eng. News Publ. Co. 294 p. 12°.

THE progress in developing material resources, in recent years, has created a vast amount of engineering literature, which is scattered through the various engineering journals. To render a large amount of this available, has been Mr. Galloupe's task, who has sought, in a handy little volume containing about ten thousand references, to cover the contents of the leading journals during the past five years. The matter seems to be arranged admirably under topics. The book will certainly serve a purpose with all interested.

NOTES AND NEWS.

MR. G. W. LITTLEHALES, assistant in the Hydrographic Office, has completed a monograph on 'Recent Developments in Great Circle Sailing.' Lieutenant Dyer, in charge of the office, who has devoted much time and labor to the study of this subject, will write the preface. —— Henry Holt & Co. announce as in preparation, 'Briefer Course in Physics,' by George F. Barker; 'Dissection of the Dog,' as a basis for the study of physiology, by W. H. Howell; 'Brief History of the United States,' by Alexander Johnston, professor in Princeton College (this book is intended to meet the needs of teachers who desire a briefer and more elementary text-book than the author's well-known 'History of the United States;' it is, however, very far from being a condensation of that work); 'Greek Literature,' by Thomas Sergeant Perry; 'Chemistry (Advanced Course),' by Ira Remsen; 'Das Wesentliche der Deutschen Grammatik,' by A. W. Spanhoofd; and 'First Lessons in Political Economy,' by Francis A. Walker. —— D. Van Nostrand, New York, announces 'The Elements of Electric Lighting,' by Philip Atkinson, for speedy issue; also 'Modern Reproductive Processes,' being a manual of instruction in the art of reproducing drawings, engravings, manuscripts, etc., by the action of light, by Mr. Ernst Lietze; a translation of the Russian work of Woeikof on 'The Climates of the Earth,' by Prof. Cleveland Abbe of the Signal Office; a large and important work by Col. George E. Waring, jun., being a general treatise on city, town, and village sewerage and drainage, and land drainage; and 'Plate Girder Construction,' by Isami Hiroi, the latest issue in the Van Nostrand's Science Series. —— G. S. Fellows & Co., New York, announce 'Memory Systems, New and Old,' by A. E. Middleton. This is the first American edition from the second English edition, revised and enlarged, with bibliography of mnemonics, 1325–1888, by G. S. Fellows, M.A., of the Washington High School. They also announce 'Protection Echoes from the Capitol,' by Thomas H. McKee, containing twelve hundred aphorisms and leading principles of the protective policy. —— Cupples & Hurd have in press a volume on 'Typical New England Elms and Other Trees.' —— Harper & Brothers have just ready Walter Besant's 'Fifty Years Ago.' This is an illustrated account of English life, customs, and manners half a century ago, when Queen Victoria ascended her throne. —— G. P. Putnam's Sons publish 'The Story of Media, Babylon, and Persia,' including a study of the Zendavesta or religion of Zoroaster from the fall of Nineveh to the Persian war (continued from 'The Story of Assyria'), by Zénaïde A. Ragozin, in their Story of the Nations Series, illustrated with maps and woodcuts; and 'A Sketch of the Germanic Constitution,' from early times to the dissolution of the empire, by Samuel Epes Turner. —— Roberts Brothers publish 'Harvard Vespers,' a volume of addresses to Harvard students, by Francis G. Peabody, Phillips Brooks, Edward Everett Hale, Alexander McKenzie, George A. Gordon, and Andrew P. Peabody, delivered during 1886, 1887, and 1888. —— James J. Chapman, Washington, D.C., will issue early in September McPherson's 'Hand-book of Politics for 1888.' It will cover the proceedings of the second session of the last Congress (49th), and the first session of the present Congress (50th), and will give the final facts as to every pending public measure. —— *Das Centralblatt für Bibliothekswesen* for July contains a remarkable article by J. Gildemeister of Bonn, on the 'Oriental Literature of the Discovery of America,' containing some curious particulars, taken from a Mohammedan work, of the voyage of an Indian ship, which, after driving about in the ocean for eight months, was cast on to the shore of the New World. —— For the first time in its history *The Century* will devote a single issue — the forthcoming September number — largely to educational themes. The contributions will include 'The University and the Bible,' by T. T. Munger, a plea for the study of Christian as well as Heathen classics; 'Women Who go to College,' by Arthur Gilman; and 'The Industrial Idea in Education,' by Charles M. Carter. One illustrated paper is on 'College Fraternities,' with pictures of twenty-eight chapter-houses and society-halls at Yale, Harvard, Princeton, and other colleges; and another is on 'Uppingham, an Ancient School worked on Modern Ideas,' with a number of illustrations by Joseph Pennell, and a portrait of the late head master, Edward Thring, who is said to be, since Arnold of Rugby, the most highly esteemed educator of England. There will also be several important short editorial articles and 'open letters' on different branches of the same subject. Other distinctive features of the magazine, the Lincoln history, Siberian papers, fiction, etc., will, however, be retained. —— The Washburn and Moen Manufacturing Company of Worcester, Mass., has just published the sixth edition of their 'Pocket Handbook of Copper and Iron Wire in Electric Transmission.' The book contains a summary of information in regard to the telegraph and telephone in addition to that about wires. —— Van Antwerp, Bragg, & Co. have just ready 'Eclectic Physical Geography,' containing 30 charts and 151 cuts and diagrams. —— G. P. Putnam's Sons will publish immediately an *édition de luxe* of 'The President's Message,' printed in large type, small quarto, with sixteen full-page moral and graphic illustrations from original designs by Thomas Nast; also the Questions of the Day edition of the same, with annotations by R. R. Bowker, which has been delayed for some important additional material. —— Cupples, Upham, & Co. will publish shortly a new book by W. H. H. (Adirondack) Murray. It will be descriptive of the north-western side of the American continent. —— Funk & Wagnalls have just issued in

pamphlet form 'The Presidential Campaign of 1896 — a Scrap-Book of Chronicle,' by the author of 'The Battle of Bietigheim.' The occasion is the presidential campaign of 1896, when the combined forces of socialism, anarchy, and atheism meet their Waterloo at the hands of an aroused, living, active American patriotism. —— D. Appleton & Co. publish 'A History of the United States and its People,' by Edward Eggleston. They have also just ready in the International Scientific Series 'The Origin of Floral Structures through Insect and Other Agencies,' by the Rev. George Henslow, professor of botany, Queen's College; and 'Seven Conventions,' by A. W. Classon, which refers to the Federal convention, five of the ratifying conventions, and the Charleston convention of 1860, and is designed as an aid to the study of the Constitution. —— William Henry Hurlbert has just published in Edinburgh a book entitled 'Ireland under Coercion — the Diary of an American.' Mr. Hurlbert concludes that landlords are good and alone deserving of sympathy, and that the nationalist peasants are vicious, dishonest, and, as a rule, much too leniently treated. —— Sir Morell Mackenzie is at work on his reply to the recently published attack upon him by the German physicians. His answer will be shortly published in book form simultaneously in England and Germany. Messrs. Sampson Low, Marston, & Co. will be the English publishers. —— L. J. Veen, Amsterdam (Holland), has just published the first part of a 'Dictionary of National Biography,' by J. G. Frederiks and F. Jos. van den Branden, assisted by a number of prominent men of letters in the Netherlands. The work will be completed in fifteen parts. —— W. Drysdale & Co., Montreal, Canada, have just ready a new Canadian work, entitled 'The Young Seigneur, or, Nation-Making,' by Wilfrid Chateauclair. The chief aim of this book, the author says, is to map out a future for the Canadian nation, which has been hitherto drifting without a plan. A lesser purpose of it is to make some of the atmosphere of French Canada understood by those who speak English. —— Ticknor & Co. announce among their September books, 'Western China,' a journey to the great Buddhist centre of Mount Omei, by the Rev. Virgil C. Hart, B.D.; and 'A Short History of the Secession War,' by Rossiter Johnson, author of 'The History of the War of 1812–15.'

— Mr. Norman J. Fake, assistant to Professor Wiley, chemist of the Agricultural Department, was accidentally drowned while bathing in the Potomac on Saturday, Aug. 11. He was a young man of great promise, already an analyst of much skill, enthusiastic in his work.

— Professor Wiley of the Agricultural Department will complete his long investigation of the adulteration of lards in about six weeks. He will then take up the subject of the adulteration of sugars, molasses, and honey.

— *The Edinburgh Scotsman* of Aug. 16 states that on the day before, Mr. C. Piazzi Smyth, in consequence of advancing years, retired from the offices of astronomer royal for Scotland, and professor of practical astronomy in the University of Edinburgh, which he has filled for the long period of forty-three years. These important positions are in the gift of the Crown, and, although correspondence with the secretary for Scotland on the subject of his retirement has not yet been finally completed, Professor Smyth has, as already indicated, ceased from active duty, having handed over the keys of the Royal Observatory, in terms of an arrangement with Lord Lothian, to the first assistant astronomer, Mr. Thomas Heath, B.A. A week hence Professor Smyth, who is in his seventieth year and is still hale and hearty, will leave the official residence, 15 Royal Terrace, Edinburgh, and take up his abode ultimately in England. The late astronomer royal was born of English parents in the city of Naples, the roof under which he first saw the light being so close to Vesuvius that every now and then both house and garden were covered with showers of black sand. Prior to coming to Edinburgh he was for ten years at the Cape of Good Hope, in the capacity of first assistant astronomer in the Royal Observatory there, under Sir Thomas Maclear. During that time Professor Smyth went through a large amount of rough work in measuring an arc of the meridian along the mountains of the west coast of Africa. Altogether, therefore, he has spent fifty-three years of his life in observatory work. Professor Smyth, in a recent conversation, went into some detail as to his labors at the Royal Observatory, and his reasons for resigning. His reason for proposing retirement to Lord Lothian, he remarked, was not only advancing years, but despair of ever being able to do any thing good, or compete with other observatories, when the government continued to refuse to do what their own commission recommended.

— Prof. E. J. Loomis of the Nautical Almanac Office is about to visit the Rocky Mountains on a vacation trip. While there he will assist his son-in-law, D. P. Todd, director of the Amherst College Observatory, in making scientific observations, astronomical, spectroscopic, and photographic. The expedition starts from Boston, and goes by the way of Montreal and the Canadian Pacific Railroad to the most elevated point in the Rocky Mountains reached by that railway. There the party will stop, and select the highest point near at hand, and conveniently accessible for the erection of a temporary observatory. Professor Todd goes out under the auspices of the Harvard College Observatory.

— C. N. Caspar of Milwaukee publishes the first instalment of Part I. of his 'Mail Book Auction.' Two copies of this list, which contains only the titles of books actually in stock, are sent to librarians and private book-collectors. One of these lists may be used to affix, after the respective titles of the works desired, the price the bidder is willing to pay per volume for each work. The second copy of the list, marked with the same bids, should be kept for reference. The advantages of this strictly new arrangement are conspicuous, and, above all, labor-saving. Old books in most cases have no market-value, and are, as a rule, worth different prices to different persons. Librarians and others may, through this opportunity, obtain books at their own prices. The books will be shipped to the first bidder, if the offer proves acceptable; otherwise the bids will be filed, and the books kept for four weeks for competition of offers which may arrive during this period, after which time they will be sent out without reserve to the highest bidder. All books on this list are warranted to be perfect, complete, and in good condition, and they are in their original cloth binding, if not otherwise specified. They will be forwarded at the expense of the purchaser. No charge is made for packing, cases, or cartage.

— The New York Agricultural Experiment Station (Peter Collier, director), Geneva, N.Y., proposes to carry out this next year experiments on the influence of fertilizers on the chemical composition of plants, with analyses of the feeding-stuffs, and feeding and digestion experiments.

— Mr. Ellery C. Huntington, A.B., of Amherst College, Massachusetts, will form classes in physical culture at the beginning of session, 1888–89, at the University of Virginia. The work under personal supervision of the instructor will consist of (1) class exercise with light (wooden) dumb-bells, (2) class drill with chest weights, (3) class exercise with Indian clubs. In addition, each student is to be examined physically and measured at least once a year. On the basis of this examination, a handbook of developing exercise will be made out and given to him, with exercises marked that are adapted to his individual need.

— A despatch from London, Aug. 27, announces the death of Philip Henry Gosse, F.R.S., the English naturalist, aged seventy-eight years. Mr. Gosse was born at Poole, Eng., in 1810, went to Newfoundland when a boy of seventeen, eight years later removed to lower Canada, and then travelled in this country, studying zoölogy and entomology, and making a long stop in Alabama. He was made an F.R.S. in 1856. He was the father of Edmund W. Gosse, the critic and poet.

— The Agricultural Department is organizing five new experimental stations for the study of sorghum and its manipulation, — three in Kansas, one in New Jersey, and one in Louisiana. The appropriation for this work this year is one hundred thousand dollars, larger than it has ever been before.

— Ohio and Michigan are better provided with public-school libraries than any other States. The former has 191 and the latter 154 volumes for every 100 pupils in average attendance. In the Southern States no public-school libraries of any consequence are reported.

Publications received at Editor's Office, Aug. 20–25.

ELECTRIC Transmission, Pocket Handbook of Copper and Iron Wire in. 6th ed. Worcester, Mass., Washburn & Moen Manuf. Co. 80 p. 48°.
HILGER, A., KOENIG, J., KAYSER, R., and SELL, E. Vierteljahresschrift über die Fortschritte auf dem Gebiete der Chemie der Nahrungs-und Genussmittel. 2d ed. Berlin, Springer. 692 p. 8°.
OHIO Meteorological Bureau, Fifth Annual Report of the, for the Year 1887. Columbus, State. 194 p. 8°.
PARKER, F. W. How to Study Geography. Englewood, Ill., The Author. 400 p. 12°.
PROCTOR, R. A. Old and New Astronomy. Parts IV. and V. London and New York, Longmans, Green, & Co. 128 p. 8°.
THYS, Captain. Au Congo et au Kassaï. New ed. Bruxelles, Weissenbruch, pr. 61 p. 8°.
—— Le Kassaï et la Louloua de Kwamouth a Louebo Levés a Bord du Steamer "Stanley." Bruxelles, Inst. Nat. Géog. 8°.
TRAPHAGEN, F. W. Index to the Literature of Columbium: 1801–1887. Washington, Smithson. Inst. 27 p. 8°.
TUCKERMAN, A. Index to the Literature of the Spectroscope. Washington, Smithson. Inst. 423 p. 8°.

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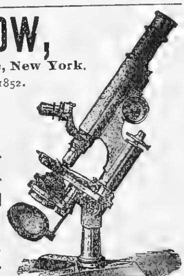

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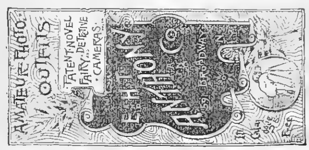

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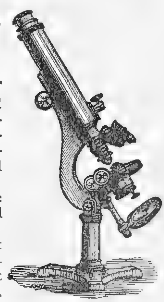

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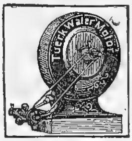

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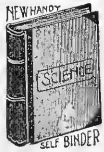

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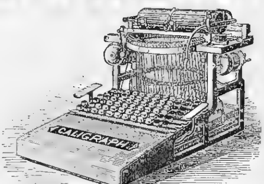

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SCIENCE

FRIDAY, SEPTEMBER 7, 1888.

ONE OF THE IMPORTANT functions of a State geological survey is to furnish accurate and impartial information on the general character of so-called 'mining districts.' Nearly all of our State geologists have had experience in such matters, from the early days when the 'black shale' was exploited for coal, to the later times, when certain iron-fields in Wisconsin needed discouragement. The most recent example comes from Arkansas, where much excitement has arisen in a mining district from which rich discoveries of valuable metals were reported. Professor Branner, recently appointed State geologist, was called upon to examine the region and its ores, and as he failed to find evidence of value in them, and clearly stated his unflattering results in a brief report, he is now made the object of violent abuse from the parties whose hopes are dashed by his work. The better people of the State, however, are with him, and, with their support in his honest course, we shall hope to see his survey continue and thrive. He was elected secretary of the geological section of the American Association at the Cleveland meeting, his nomination being in part due to a desire on the part of his colleagues to express their appreciation of his integrity and their approval of the course he has taken.

THE IMPORTANCE OF PRESERVING the forests becomes evident in South Africa. J. G. Gamble, in the Proceedings of the Institute of Civil Engineers, points out that the soil of Africa becomes dryer every year. Although the amount of precipitation is not decreasing, the springs become less strong, and rivers that used to flow permanently are dry during summer. Gamble considers the devastation of forests, and the grass and bush fires, the principal reasons for this state of affairs. Besides this, the trails made by animals are transformed into cañons of considerable depth by sudden rainfalls. In these cañons, which are in some cases more than thirty feet deep, the surface water runs off before it has time to percolate the soil. Tripp has made observations on the amount of evaporation, and found that on the highlands fully one-half of the falling rain runs off without penetrating into the soil. This experience emphasizes the fact that the ultimate aim of rational forest-culture, so far as its influence upon agriculture is concerned, is the increase of the power of the ground to hold moisture, and thus to prevent the rapid flowing-off of the precipitated rain.

THE PILOT CHART for September, under the title 'Transatlantic Routes,' refers to the collision between the two Danish steamships 'Geiser' and 'Thingvalla,' Aug. 14, about thirty miles south from Sable Island, the sinking of the former in a few minutes, and the drowning of 117 persons, and adds, "The Pilot Chart for December, 1887, discussed this subject of transatlantic navigation at some length, and a supplement was published calling attention to the importance of some general understanding as to the routes to be followed by eastward and westward bound vessels. The plan thus inaugurated has been adhered to each month since that time, one track being plotted as the southern limit for westward-bound vessels, and another as the northern limit for eastward-bound vessels." This discussion, in which it was stated to be "the object of this chart to recommend only what masters of vessels may reasonably be expected to follow, having due regard to the mutual benefits to be derived from such an agreement, as well as the mutual concessions to be made in order to make it effective," was reviewed editorially at some length in No. 256 of *Science*, so that it is unnecessary to repeat it here; but it is pertinent to remark, that on the Pilot Chart for each of the last ten months the transatlantic routes recommended for eastward and westward bound steamships for the succeeding month have been carefully plotted; and this fact adds startling emphasis to the closing sentence of the note on the September chart, which is as follows: "This recent disaster would not have occurred had the 'Geiser' been farther to the southward, as recommended for eastward-bound vessels; and the collision thus emphasizes the importance of this matter, not only to owners, agents, masters, and marine underwriters, but to the public generally." This fixes the responsibility for the loss of the 'Geiser,' and the appalling sacrifice of life and property that resulted, beyond the possibility of question; for, as every reader of *Science* knows, the Pilot Chart is published on the first day of each month, and enough copies are furnished at each Atlantic port of the United States to furnish a copy, free of cost, to every vessel that departs during the month. The captain who does not pay heed to its recommendations assumes a fearful personal responsibility, which should not be overlooked in fixing the severity of the punishment he is to receive if disaster results from this neglect. The work of the United States Hydrographic Office is universally recognized as the best of its kind done in the world, and mariners cannot afford to disregard its recommendations.

MR. EVERETT HAYDEN, who is in charge of the meteorological division of the Hydrographic Office, and who has recently distinguished himself by his exhaustive study of the great storm of last March, the results of which are about to be published at length, illustrated by a series of six superb charts, as well as by his contributions to the monthly Pilot Chart, which, under his direction, has become a most wonderful compendium of information that is of vital interest to mariners, has been authorized by Commodore Harmony, acting secretary of the navy, to go to Havana, Cuba, for the purpose of studying the laws of hurricanes. Mr. Hayden will visit the observatory of the Real Collegio de Belen, in Havana, the director of which has carried the study of hurricanes further than any other student of the subject in the world; and he will carry from Washington a great mass of material which he has already collected, and which he hopes to work up in the light of additional information which he expects to obtain in Havana, and from the actual observation of hurricanes during the remainder of the hurricane season. Mr. Hayden expects to be absent about six weeks. Very soon after his return he will make a special report. He also hopes to be able to qualify himself, as no one in the United States is now qualified, to discuss hurricanes in such a manner as to be able to give to the navy and commercial marine of this country, and of all other countries whose ships navigate the North Atlantic Ocean, much most valuable, practical information, and to contribute important data to the science of meteorology.

PHOSPHORUS PENTOXIDE AS A DISINFECTANT.

SINCE the publication in *Science* of the report of a series of experiments conducted by the Marine Hospital Service at the quarantine station below New Orleans to determine the efficacy of the different disinfectants used, and especially since that article has been copied in so many of the medical journals of the country, great interest has been manifested among quarantine officers, city health-officers, sanitarians, and chemists, in the discovery of some additional disinfectant. Phosphorus pentoxide was suggested, and

its use widely advocated, on account of its supposed deadly effect upon disease-germs and the convenience of its use. The amount of phosphorus required to produce a given volume of fumes is so much smaller than that of sulphur, and it can be so much more easily placed in the most favorable positions for its fumes to reach the article to be disinfected, that there was a general inclination to substitute it for sulphur.

In order to ascertain definitely what the value of phosphoric acid is as a disinfectant, Surgeon-General Hamilton, about three weeks ago, as was noticed in *Science* at the time, instructed Dr. Kinyoun, surgeon in charge at New York, to make a series of experiments with phosphorus pentoxide for the purpose of determining its utility and applicability for general disinfection. Dr. Kinyoun has made his report, and it will be printed in Dr. Hamilton's abstract to-morrow. He has courteously consented that it shall be published in the present number of *Science*. It is as follows: —

"I have the honor to state that I have, in accordance with your instructions as per letter of Aug. 15, made a series of experiments with the fumes of phosphorus pentoxide, in view of determining its utility and applicability for general disinfection. As a fact well known in chemistry, when phosphorus is ignited in a full supply of air, phosphorus pentoxide is formed, being a white amorphous powder, volatilized by heat, and absorbing moisture with the utmost avidity. It unites with water, forming hydrogen phosphate or phosphoric acid.

"When phosphorus is ignited in a closed vessel, the amorphous powder of phosphorus pentoxide is precipitated on the bottom and sides. It is never in suspension longer than forty minutes after the combustion has been completed.

"For the purpose of experimenting, a cask holding five hundred litres was made use of for testing the germicidal powers of the oxide. At first the phosphorus was placed in the bottom of the cask; but it was found necessary to place it near the top, and protect the cask by asbestos, on account of the great heat involved. This procedure gave as a maximum heat at the bottom, where the cultivations were placed, 32° C.

"The first observation was made to determine the penetrating-power of phosphorus pentoxide, which was done in the following manner: Fifteen test-tubes ($1'' \times 5''$) were used, in which were placed several pieces of litmus that had been rendered alkaline by a solution of carbonate of soda. All the strips of paper were saturated before being placed in the tubes. Several of the tubes were left open, and were put in several positions, — some vertically, mouths upward; some horizontally, and then suspended mouths downward. Another series was covered with one, two, three, and four layers of dry filter-paper. Another series was covered with muslin, one, two, three, and four layers. A fourth was covered with flannel, one, two, three, and four layers. A fifth was covered with cotton, one, two, three, and four layers.

"All the above were placed in various positions in the vessel, and twenty grams of phosphorus ignited, and the cask sealed. It was opened twenty-four hours thereafter. There was no change observable in the color of the litmus-paper in those tubes that had been closed with the substances as noted above. In the tubes that were open, all had been acted upon by the acid, most in those which had been placed mouths upward, and least in those suspended mouths downward.

"The test-tubes that were covered with paper, etc., were placed under a large bell jar, and a small quantity of sulphurous oxide thrown in, and in less than one minute all the litmus was turned red. In another experiment on letters, newspapers, etc., having been perforated in the manner that is practised at the fumigating station at Waycross, Ga., each package having several pieces of litmus placed in the centre, exposure for twenty-four hours was made, and but little effect was observed. The litmus that had been perforated showed a slight discoloration around the point of puncture. Sulphurous oxide accomplished it in a few minutes.

"The micro-organisms that were exposed were recent cultivations of anthrax, yellow-fever (Finlay), typhoid-fever, Asiatic cholera, and cholera nostras, the nutriment medium being agar-agar. All the cultivations were made in shallow dishes about an inch and a half deep and three inches in diameter. These were classed in several series, the same as was done with the test-tubes, covered as follows: series 1, of anthrax, typhoid, cholera Asiatica, cholera nostras, and yellow-fever, covers of dishes removed; series 2, covered with filter-paper, dry; series 3, covered with muslin, dry; series 4, covered with flannel, dry; series 5, covered with a thin layer of absorbent cotton.

"These were exposed for twenty-four hours, then examined. In the dishes that were left open was found a certain, quite a considerable, quantity of phosphorous acid, and all the germs were found to be killed. In those that were covered with paper, etc., no change was noted, and innoculations from them showed all to be alive. Each cultivation was also tested for the presence of the acid in the medium, but in no instance was it to be found.

"These experiments were made several times, always with the same results. An attempt was also made to force the fumes of the acid through absorbent cotton, using for the purpose a large glass cylinder loosely packed with cotton. One hundred and twenty-five grams pressure was made, but none of the fumes came through it. This was readily accomplished with sulphurous oxide.

"Our conclusions are that the phosphorus pentoxide is a surface disinfectant *only*, having little if any penetrating-power, and is wholly unfit for fumigation and disinfection where penetration is desirable; that its limited scope of usefulness is altogether met in the use of bichloride of mercury. No observations on the spores of micro-organisms were made, as it gave negative results in fresh cultivations of the different germs tested."

HEALTH MATTERS.

Wounds of the Abdomen.

WE mentioned in a recent number of *Science* a suggestion made by Professor Senn of the use of injections of hydrogen-gas into the intestines to detect the presence of perforations in cases of gunshot or stab wounds of the abdomen. Professor Senn demonstrated the practicability of this method upon dogs, but, we believe, had no opportunity of applying it to the human species. Since then the method has been used in several cases with success. Dr. Mackie of Milwaukee, in the *Medical News*, reports its use in a pistol-shot wound of the abdomen. His method is thus described: "The patient was etherized, and rectal insufflation effected in the following manner. A four-gallon rubber bag, filled with hydrogen-gas, was connected by rubber tubing with the long glass tube of an extemporized chemical wash-bottle half filled with water. To the short glass tube, passing through the cork only, was attached, by rubber tubing, the rectal nozzle of an enema syringe. This bottle was introduced so that the rapidity of inflation could be judged of by the bubbling of the gas through the water. When the rectal nozzle had been introduced, slow, steady, and continuous pressure was made on the rubber bag. Under very slight pressure, the gas commenced to bubble through the water. As inflation progressed, the abdomen, previously flat on percussion from the umbilicus to pubes, became resonant, and the area of liver-dulness diminished from below upward. The inflation was continued until the abdomen became uniformly distended and tympanitic throughout. Still no gas escaped through the wound of entrance, although kept at the highest level. On firmly compressing the abdomen, there occurred an intermittent escape of gas mixed with blood through the wound of entrance. To demonstrate the presence of hydrogen by ignition of the escaping gas, matches were employed. These proved very unsatisfactory, for a burning match never once happened to be directly over the wound of entrance when the gas was escaping. The taper, as used by Senn in his experiments, had, in the hurry of preparation, been overlooked. The escape of gas from the wound of entrance positively proved that the gastro-intestinal canal had been injured, so that further attempts at ignition were superfluous."

In concluding the report of this case, Dr. Mackie says that it was impossible to diagnosticate, from the symptoms, perforation of the gastro-intestinal canal. The position of the wound of entrance, and the character of the vomit, were presumptive of injury to the stomach. The general direction of the bullet, and the position of the wound of exit, pointed to injury of the descending colon or kidney: still both were intact. The symptoms of intra-abdominal hemorrhage were not so marked as to justify a laparotomy.

The escape of gas from the wound of entrance, after rectal insufflation of hydrogen-gas, afforded positive evidence of perforation existing somewhere in the gastro-intestinal canal, and on this evidence alone was laparotomy performed. The perforations were so situated as to put this diagnostic measure to the severest test. It was found reliable, and further experience will prove that it is as infallible in the human subject as Senn has found it in animals. It never once failed.

In conclusion, we come to the medico-legal aspect of this case. The man who did the shooting has been committed for trial. The symptoms present were only presumptive of the existence of perforation, until rectal insufflation was made. Had an exploratory laparotomy been performed with the above fatal result, and no intra-abdominal lesions sufficient to warrant such a grave operation been found, the position of the surgeon would have been very embarrassing. The defence might affirm that the surgeon ought to be held responsible for the patient's death, and not the defendant. Naturally, this would deter one from operating; but if the surgeon can demonstrate, by rectal insufflation of hydrogen-gas, the presence of diffuse tympanites due to escape of gas through a perforation into the peritoneal cavity, even without the escape of gas through the external wound, he may rest assured that perforation exists somewhere in the gastro-intestinal canal, and he can then safely proceed to the necessary operative treatment without incurring any medico-legal responsibility.

Dr. William J. Taylor, in the same journal, reports the successful use of this means of diagnosis in another case.

ANTISEPTIC AMMUNITION. — According to the *Medical Press* of May 9, a useful suggestion is being carried out by the Netherland Government, by which provision will be made for supplying each soldier, during the time of war, with a cartridge containing some antiseptic dressings. Each cartridge will be made of convenient size, namely, about three inches in length by two in width, and will be secured at one end with a safety-pin. The dressing contained in each will consist of a bandage about three yards long, and two pieces of gauze, all of which have been rendered antiseptic by a sublimate solution. Hence, in the event of wounds being received, a ready means would be at hand for the immediate application of antiseptic dressings. Soldiers, in the case of slight injuries, would probably at once avail themselves of the dressings, and the latter could not fail to be of much use to the surgeons. The idea is well worthy of the attention of the military authorities in this country, and might even with advantage be adopted, as it has been for years past in the German army. In the wars in which, during the past few years, England has been engaged in tropical climates, the early application of antiseptics to the wounds received by the men was admitted to be a matter of the utmost importance by the army medical officers attached to the forces.

A MEDICO-LEGAL CASE. — The following case of suicide, which recently occurred in Jamaica, presents features of considerable interest and no little importance. A colored man, after murdering his sweetheart, entered his house, and cut his throat with a razor. Some of the neighbors who had witnessed both deeds rushed into the house, but were unable to find him. After a search, his dead body was found under the house, which was a small one, built on supports, raising it about two feet from the ground. After cutting his throat, the man must have walked or run to the back entrance, a distance of sixteen feet, and then have crept through a hole in the partition, and have crawled on all-fours to the spot where his body was found, exactly beneath the room where he cut his throat, and therefore a further distance of sixteen feet. The throat was cut from ear to ear by a clean sweep, both carotids and jugulars being severed, as well as the trachea and œsophagus, the wound reaching back to the anterior portions of the bodies of the cervical vertebræ. A blood-stained razor, which was deeply notched, was found in the room, and marks of blood were traced from the room to the back entrance, by which the man must have gone out. Remarkable instances of the retention of voluntary power after wounds of the carotid artery, have been occasionally recorded; but *The British Medical Journal*, June 30, in commenting on the case, says that they know of no occasion on which the vessels on both sides of the neck were divided, where so much power was retained by the subject of the injuries as in the present instance. The case should serve as a perpetual warning to medical men not to be too dogmatic as to what is, and what is not, possible, even in the presence of the most rapidly fatal wound.

VACCINE VS. BOVINE VIRUS. — The fear of contracting disease has to a great extent done away with the use of vaccine virus taken from the arm of a vaccinated child, and caused physicians, oftentimes against their judgment, to confine themselves to bovine virus. That this latter virus is not always innocuous is well shown by a report of the Royal Bureau of Hygiene at Berlin. Virus which was obtained from a vaccine-farm at Eberfeld produced in those who were vaccinated with it eruptions of the skin, and in some instances pustules formed. Among children, several deaths occurred. In one of these cases post-mortem examination revealed an abscess. Considerable constitutional disturbance followed the occurrence of the eruptions. Contagion seemed to be promoted by schools and the occurrence of the harvest. By order of the government, the vaccine-farm was temporarily suspended, all instruments and appliances were destroyed, the buildings most thoroughly disinfected, and the heifers destroyed. Vaccine-lymph subsequently produced at this farm was excellent in its results. The physician in charge sent a specimen of lymph to Berlin for examination. The microscope showed isolated bacilli, and numerous micrococci which multiplied in chains and did not liquefy gelatine. No control experiments by inoculation were made.

THE MICROBE OF DYSENTERY. — Chantemesse and Widal report the discovery of a specific bacterium in dysentery (*Progrès Médical*, April 21, 1888). Working in Cornil's laboratory, they have studied five cases of tropical dysentery, and have found the same microbe in the lesions and stools of a fatal case and in the stools of four others. The bacteria were found in colonies in and between the tubular glands of the intestine, in the lymph-glands, and spleen. The organisms develop rapidly at the ordinary temperature, thriving on all the usual culture media. They are bacilli, with rounded ends, and somewhat thicker in the middle than toward the extremities. They grow luxuriantly in sterilized water from the Seine. Fed to guinea-pigs, pure cultures produce intestinal inflammation and necrosis, the stomach itself being affected. The lesions are more marked when the gastric contents are rendered alkaline. Intraperitoneal injections cause death in two or three days with peritonitis, pleuritis, and pericarditis. The liver is affected in these animals, necroses with colonies of bacilli being found in the portal areas. All the lesions in the experimental cases furnished pure cultures of the bacillus. From these facts, and the absence of the bacillus in the fæces of healthy men, Chantemesse and Widal feel justified in claiming specific properties for this bacillus. In commenting on this paper, the *Medical News* says, that, although the observations made are too few in number to bring absolute proof, they are of interest as being the first in which so much has been accomplished. Numerous other investigators have described micro-organisms in dysentery; but none, up to this time, have succeeded in cultivating them. Further developments will be awaited with interest.

ELECTRICAL SCIENCE.

The Danger of Alternating Currents.

THERE has been a warm discussion before the Board of Electrical Control in New York as to the relative danger of continuous and alternating electric currents. Communications, most of them of a partisan nature, have been addressed to the board, and statements of a directly contradictory character have been made. Mr. Harold P. Brown, who champions the continuous-current side, has put the matter to a practical test by experiments tried at Columbia College July 30 and Aug. 3. He has killed a number of dogs, using both types of current, and he draws the conclusion that the alternating current is much the more dangerous. On July 30 only one dog was experimented on. The continuous current was first tried, the electro-motive force being increased from 300 to 1,000 volts, and the result was not fatal; then an alternating

current of 330 volts was turned on, and the dog was killed. Further experiments were prevented by an agent of the Society for the Prevention of Cruelty to Animals. This was unfortunate, as the result was distinctly unfair to the alternating side of the question, since a dog that had been subjected to a 1,000-volt continuous current was hardly in condition to stand very much more, no matter under what form the shock came. On Aug. 3, however, the experiments were repeated on a number of dogs, before Dr. Cyrus Edson and a number of physicians and electricians. The main results are embodied in the letter to *Science* published Aug. 10. In this letter three cases are mentioned, in each of which a strong and healthy dog was killed by alternating currents whose voltage varied from 340.5 (the highest) to 234 (the lowest). In some further experiments given by Mr. Brown in the *Electrical World*, a number of dogs were killed by alternating and by continuous currents. The maximum alternating-current voltage that was taken without death resulting was 500; continuous-current, 1,420 volts. Minimum alternating current that caused death was at 188 volts; continuous current, 800 volts. The physicians present expressed the opinion that a current which killed a dog would be fatal to a man under similar conditions.

If these experiments were conclusive, they would mean that alternating currents would destroy life at less than half the voltage that would make continuous currents dangerous. This is partly due to the fact, that when we measure alternating electro-motive forces by a Cardew voltmeter, such as was used in Mr. Brown's experiments, we measure the mean, not the maximum, electro-motive force; which last is, very roughly, half again as much. Still, as we always consider the mean electro-motive force, and as the alternating system uses a mean electro-motive force of 1,000 or 2,000 volts, whichever it may happen to be, we must drop the distinction between mean and maximum, or we must carry it into our practical work. Both these experiments are contradicted by the statements of various people that they have taken alternating electromotive forces as high as 1,000 volts without inconvenience. Still, until these statements are more definite as to the conditions under which the shocks were taken, we may consider that Mr. Brown has the upper hand.

But, whatever may be thought of Mr. Brown's experiments on dogs, they add to the evidence pointing to the fact that an alternating current of 1,000 volts electro-motive force would be fatal. Such a pressure is far above the limit set by M. d'Arsonval, and few fair-minded persons will doubt its danger. This being the case, the question arises, Should a system using such a pressure be allowed for house-to-house distribution in crowded cities? Under certain circumstances, this could be safely done; under others it could not. If the wires can be taken over head, and if the converters may be placed on poles in front of the houses, the low-pressure secondary circuit alone entering the house, then the system, if properly installed, is reasonably safe, and should not be objected to on that score. If it is necessary, on the other hand, to put the wires under ground, and to bring them into houses to supply converters in the cellar, say, then the system is not safe, nor will it be economical; for the trouble and expense of keeping a network of high-potential mains in order, leaving out the danger, will take from the economy and popularity of the system. The rational and safe way of using the system, in a city where overhead wires are not allowed, is to have a number of sub-stations in the district to be lighted, to which the high-potential mains are taken, and from which current is distributed to the houses at a low potential. On this latter plan, there is no reason that the system should not be used in New York or anywhere else. The high-potential conductors are less dangerous than the arc-light circuits; for they are tapped at fewer places, and the current is not taken into any house at a pressure high enough to cause death. It is, in fact, the only safe method of alternating-current distribution under ground. We hope that it will be tried, and that it will succeed.

A NEW ELECTRO-DYNAMOMETER. — M. Pellat has devised an electro-dynamometer which seems sensitive, and whose constant may be determined with accuracy from measurements. It consists of two cylindrical coils of wire, one within the other. The axis of the longer and larger one is horizontal, that of the smaller is vertical, and the two axes intersect at their middle points. If, now, a current be sent through the coils, — the outer one being fixed, the inner movable, — the axis of the latter will tend to place itself parallel to that of the former. The smaller coil is at one end of a scale-beam, and its tendency to move is balanced by weights added to the pan at the other end. The current is calculated from the weight in the pan and the dimensions of the two coils, the latter being in the form of a constant. The current is conducted to the inner coil by two silver wires joining the support with terminals on the scale-beam, to which the ends of the coil are taken. The two most difficult measurements that have to be made are the diameter of the cylindrical coils and the distance apart of the turns of wire. The former, M. Pellat states, can be made with an accuracy of 1 part in 5,000; the latter, within 1 in 3,000; and, as we measure the square of the current, the last error would only appear as 1 in 6,000 in the result. In discussing all the sources of error, M. Pellat reaches the conclusion that the results of measurements are correct to at least 1 part in 2,000. The currents that can be measured are not greater than .6 or .8 of an ampère, the difficulty lying in the fact that in getting the current to the inner coil very fine wires must be used in connecting the stationary with the movable parts, otherwise the sensitiveness will be decreased. To allow for the effect of the earth's magnetism, the current is sent first in one direction, then in the other. The difference in the weighings is due to the magnetism of the earth. In calculating the current from a weighing, we have very simply $i = A \sqrt{p}$, where A is a constant calculated from the dimensions of the instrument, and p is the weight in the scale-pan. The sensitiveness of the instrument allows measurements to be taken within 1 in 10,000. M. Pellat proposes to use this instrument for calibrating other current-measuring apparatus, for measuring electro-motive force (using it in connection with a resistance), and for determining the horizontal component of the earth's magnetism (employing it with a tangent galvanometer).

A LIGHT-WEIGHT PRIMARY BATTERY. — In France M. Renard has experimented for some time past on a navigable balloon. In order to obtain the power necessary to direct it, he has attempted to find an electric battery that is very light for its output, the question of economy not entering. None of the primary or secondary batteries in use would answer his purpose, and a new one had to be invented. After a number of experiments, he found that the best results were obtained by a cell in which the metals were zinc and platinized silver, while the liquid was a mixture of hydrochloric and chromic acids. The liquid is not very stable, but it can be kept for several days if it is not exposed to light. There is no local action in the cell if the chromic acid in the solution does not fall below one-seventieth of the equivalent for the hydrochloric acid present. The cells are made tube-shaped, the diameter being about one-tenth of the height. The potential is 1.2 volts; and from cells weighing thirty-three pounds, 200 to 250 watts per second have been taken for two hours and a half. For a storage-battery of the same weight, the energy could not be taken out at a rate of more than 75 or 100 watts, and this at a low efficiency.

MENTAL SCIENCE.

The Effect of Practice upon Reading.

INASMUCH as all education is in essence mind-building reduced to an art, the strictly psychological study of mental phenomena must in the end yield results of high practical import. It is this conviction that has brought the psychologist and the educator into such close sympathy, and has brought the latter to eagerly await the results of the former's somewhat specialized and technical studies. To no topic is this more applicable than to the study of the times taken up by various simple psychic processes, and of the causes influencing such times. We here touch upon the very powers that the teacher aims to develop, and, if we can acquire a method of testing these powers, we are sure to learn more of their real nature. A very promising contribution in this direction has been recently published by Dr. G. O. Berger (*Philosophische Studien*, v. 1), an account of which will probably be of interest to American students.

Dr. Berger measured the time needed by the boys of the different classes of a German Gymnasium to read a given Latin passage. It will be remembered that the Gymnasium consists of six classes, or, as the three highest classes are each divided into two, of nine classes; and that the study of Latin is begun upon entering the school, and is continued with great zeal throughout the nine-years' course. The five scholars with the highest and the five with the lowest standing were chosen from each class. The average ages of these groups of ten scholars from the nine classes were 10.7, 12.0, 12.9, 14.2, 15.2, 16.4, 18.0, 18.6, and 21.6 years. The class preparatory to the Gymnasium was also tested, the average age of the boys being nine years. These last boys had no Latin instruction. Each Gymnasium scholar read (1) the first hundred words from Tacitus' 'Agricola' (Chapter I.), as well as (2) the next five hundred words, as rapidly as possible, with some sacrifice of distinctness, and (3) he again read the first hundred words with normal rapidity. The average number of seconds necessary to read a hundred words by the three tests for the boys of each class is as follows: —

Class.	VII.	VI.	V.	IV.	III b.	III a.	II b.	II a.	I b.	I a.
(1)	262	135	100	84	79	57	54	49	48	43
(2)	–	145	104	93	83	59	58	53	53	45
(3)	–	134	95	84	79	61	56	57	53	52

We see at once that the higher the class, the less time does it take for the boys to read Latin, and that this shortening of the time is in conformity with the general law of practice, — at first rapid, and then slower and slower. We see, too, that the most decided difference is between the boys who have had no Latin instruction and those who have just been initiated into its mysteries. The numbers in the second line are larger than in the first, indicating the difficulty of retaining this speed for a longer time. The differences are less as the boys are older, showing that the older boys have greater facility at protracted rapid reading. A similar test with Goethe's 'Egmont' (v. 2) resulted as follows: —

Class.	VII.	VI.	V.	IV.	III b.	III a.	II b.	II a.	I b.	I a.
(1)	72	55	43	37	39	28	27	26	25	23
(2)	–	56	43	39	40	30	28	26	27	24
(3)	–	48	40	39	41	33	30	33	30	30

The comparison of this table with the foregoing shows (1) the great difference in time due to the familiarity and comprehension of the vernacular; (2) that the additional effort needed to read five hundred German words is less than in the case of Latin; (3) that the great difference between VI. and VII. disappears, because all the boys are acquainted with German; and (4) that the curve of practice is generically the same in the two cases. A point of great interest, applicable to both languages, is that the difference between (1) and (3) is greatest with the older boys: in other words, when these read normally, they read for the sense, and thus slowly, while the younger boys read more mechanically. The familiarity of the passage, due to its being read a second time, even makes (3) shorter than (1).

To obviate the objection that this shortening of the time is due to a general quickening of the intellectual activities, and not to a practice in Latin, Dr. Berger tested the boys by measuring the times neces-

Class.	VI.	V.	IV.	III b.	III a.	II b.	II a.	I b.	I a.
(1) 5 colors	83	66	79	66	63	56	63	63	54
(2) 10 colors	135	99	119	123	100	91	112	99	86

sary for them to name (1) any one of a group of five or (2) of ten colors, as the above table shows this exercise, in which they have had no special practice, while exhibiting differences due to age does not at all correspond with the former differences.

The interesting point is to determine the nature of the psychic process by which this quickening of the process is brought about. If we divide the time consumed in reading into (1) the time for the impression to reach the retina and the brain, (2) that for recognizing it and calling up the appropriate sound-image, and (3) that for setting the vocal apparatus in working order, we recognize in (2) the important psychic factor. Previous experiments as well as ordinary observation have shown that the unit in reading is not the letter, but the word (adults reading a word almost as fast as a letter); that, furthermore, all the three processes overlap in time, and that the eye goes ahead of the voice. If the words are in construction, we can take in more of them at a glance, and so read faster. In the following table the first line, taken from the table above, gives the time for reading a hundred German words forming sense; the second line, the time for reading a hundred words not rationally connected.

Class.	VI.	V.	IV.	III b.	III a.	II b.	II a.	I b.	I a.
100 words in construction	55	43	37	39	28	27	26	25	23
100 words not in construction	60	50	49	48	41	38	37	38	32

The nature of the errors in reading, likewise points to a difference in the number of words grasped at one time. The youngest boys of class VII. misread letters or syllables, such as *eitra* for *citra*. Class VI. were more apt to mistake one word for another, *æstas* for *ætas*. The older boys misread sentences, but not so as to interfere with the sense. The shortening would thus be due to reading more and more words as wholes, and not as combinations of syllables. This can be verified thus: taking the classes by groups of three, the average times needed to read a hundred words in construction is, from the last table, 45, 31.3, 24.6 seconds; for disconnected words, 53, 42.3, 35.6 seconds; and the ratios of these pairs of numbers are 1.18, 1.35, 1.45, an increasing series. This means that the older boys profit more by having the words in construction than the younger ones. The same can be observed in the difference between the rapid and the normal reading of Latin, as noted above. The effect would be more noticeable in the case of Latin, for here at first the words are almost all mere sound-signs without associations with one another.

Dr. Berger then concludes (1) that the effect of practice is greatest upon the central psychic portion of the reading process; and (2) that it acts by increasing the scope of the mind, enabling it to take in more complex impressions as units, and enlarging the number of, as well as the associative links between, the impressions.

THE EFFECT OF STIMULANTS UPON THE RE-ACTION TIME. — Dr. Dehio (*Neurologisches Centralblatt*, Feb. 15) injected a dose of coffee in the form of caffeine subcutaneously, and administered tea containing 1.5 per cent of theine, and with the subject under the influence of the drug measured his re-action time, and the times necessary for simple psychic processes. He found that the simple re-action time tended to become shorter in the drugged than in the normal condition; the time necessary to choose between several modes of re-action (choice-time) was not affected one way or the other; while the time needed to find an association for a word or similar process was shortened and the variations in the times reduced under the influence of coffee, and was at first shortened and then lengthened under tea. This double effect of shortening followed by lengthening is also shown under alcohol, but alcohol affects the choice-time, while tea does not. Again: in the apperceptive processes the shortened times under tea last for some time before the lengthening sets in, while the corresponding period is brief with alcohol. The general effect of alcohol is to excite, while tea induces fatigue.

BOOK-REVIEWS.

Logic; or, The Morphology of Knowledge. By BERNARD BOSANQUET. 2 vols. Oxford, Clarendon Pr. 8°. (New York, Macmillan, $5.25.)

THIS work is an attempt to reconstruct the science of logic. The author is attached to the German school of philosophy, and acknowledges his obligations to Kant, Lotze, and Hegel. The work is divided into two parts, the first and larger part treating of judgment; the second, of inference. Mr. Bosanquet holds that the function of the intellect is always the same, whether in conception, judgment, or reasoning, and consequently that the common logic, which treats these as distinct forms of thought, is all wrong. Judgment he regards as the fundamental form of thought, the other so-called forms being either varieties of this or included in it. He recognizes the difference between judgment and inference, and defines the former as the immediate reference of an idea to reality, while in the latter this reference to reality is made mediately. One consequence of this theory of the intellectual functions is, that the author does not clearly distinguish the different parts of his subject, and treats some of them insufficiently. Thus, he holds that conception takes place only in an act of judgment; and hence he gives but little attention to conception as such, and leaves us in great doubt as to what his views of it are. Some other topics, too, that fill a large space in the common treatises, receive but scant notice in this work. The syllogism, for instance, is not treated systematically until the last chapter but one, and then it is rather discussed and criticised than elucidated. On the other hand, some subjects are introduced, such as the nature of infinity, which are not usually treated in logical works.

It will be seen, therefore, that Mr. Bosanquet's work differs quite largely from what he calls 'the traditional logic.' What is the real value of his theories we shall not undertake in this brief review to say, though they do not appear to us so original as the form and phraseology in which they are expressed might appear to indicate. But the work is suggestive, both as a whole and in special passages, and will doubtless give rise to much discussion. The contribution of an individual thinker to any branch of philosophy often consists, not in the discovery of new principles, but in the adoption of a new point of view; and this merit the treatise before us unquestionably has.

But, whatever may be the ultimate verdict on Mr. Bosanquet's theories, it is impossible not to condemn his style, which is one of the most obscure in English literature. Take, for instance, the following sentence at the beginning of the chapter on modality: "Modality, if it exists at all, is simply the degree in which individual judgments participate in the certainty of that permanent and all-embracing judgment by which the individual intelligence sustains those qualifications of the real which for it constitute reality." This is an extreme case; but there are many other passages scattered through the work that are not much more intelligible. Moreover, the author uses some phrases, such as 'really real,' and 'the ideal fabric of reality,' which to our mind convey no meaning at all. If the new logic is to become popular, it will have to express itself in plainer terms than these.

Sound, Light, and Heat. By MARK R. WRIGHT. London and New York, Longmans, Green, & Co. 12°. 80 cents.

THIS text-book by the head master of the Higher Grade School, Gateshead, a manufacturing town in the county of Durham, England, is one that will prove very suggestive to the teacher of elementary physics in our schools and colleges. It is written in a somewhat categorical style, and might prove wearisome in the classroom; but wherever it is possible to have this book at hand while performing the readily carried out experiments, it will surely prove a valuable guide. In addition to the numerous experiments, which the author deems it essential should be performed, numerous examples are introduced, the author's belief being that "science has been slow in following arithmetic in this matter." The object is to induce the student to gain by experiment, always recognizing the limitations set to the accuracy of his work, such results as he may be able to use in the solution of the problems set. The experiments demand no very large supply of apparatus, descriptions of that used being given either with the text or in the appendix. Little space is given to theoretical considerations, "a beginner's time being best spent in examining the facts of science," which facts are set down, as said above, in possibly too categorical fashion to please all.

The Spirit of Beauty. Essays Scientific and Æsthetic. By HENRY W. PARKER. New York, John B. Alden. 12°.

THE intelligent reader will wonder that the same author had written the first and the last essays in this work, so great is the difference between them in their real scientific conception. The first three chapters, making more than half the volume, have some scientific interest and value; rather, however, as criticism than as a contribution to the subject. They discuss the evolution of the beautiful, mind in animals, and the moral in nature. The author is a naturalist, and is quite familiar with the facts and views of Darwin, Spencer, and Haeckel; and whatever restrictions he may make upon them, he has made as a man who has studied the subject from the inside. But the important criticism to pass upon his strictures of evolution is, that it is the complaint of a mind which has not the courage to reconcile itself with the new environment which that doctrine has created. It is an illustration of that wide and revolutionary influence upon human thought which Darwinism will exercise, when, like the theory of gravitation, it has penetrated the lower intellectual strata of life. The observation of facts in the organic and inorganic worlds is good; the appreciation of the realistic tendencies of science is clear enough; but the reflection of sentiments and beliefs from an earlier period fortifies the judgment against taking in the full scope of the conclusions of the scientific spirit. Every thing is admitted, and even asserted as undeniable fact, except the one thing needed to give these chapters a strictly scientific value. The bias of preconceived opinions comes in to intrude views that are irrelevant, as well as doubtful and unimportant. Yet we could heartily recommend this part of the author's work to amateurs who want some criticism and interpretation along with their facts, and who wish to move cautiously amid the bewildering maze of phenomena presented in the study of animal life. The scientist will derive less benefit from it, but he will not find it without value.

It is in the last two essays, on the rainbow and life transfigured, that the most singular part of the work presents itself. It is allegory and mysticism, — the antipodes of science. They are conceived after the manner of Drummond's 'Natural Law in the Spiritual World.' They are worth noting as illustrations of that peculiar psychological constitution which is partly due to the education and prevailing beliefs before Darwinism appeared, and partly to that persistent tendency in many minds to mistake a feeling for a fact, a subjective experience for an objective reality. They may do to suggest æsthetic ideas; but it is as great a mistake to pursue the emotions aroused by beautiful analogies as if they were facts, as it is to look at poetry as science. Both science and art are the losers by it. We believe the book would be of more value without these chapters. It would certainly exercise a greater influence upon the scientifically disposed mind. The author should not have made the attempt to combine æsthetics and science in his discussion. The analysis and classification of phenomena, and the investigation of causes, are an encumbrance to æsthetics, because art is content with the relations of things, and is not interested in their explanation. Ruskin would not have committed this error; and the author is an admirer of that great art-critic.

How to study Geography. By FRANCIS W. PARKER. Englewood, Ill., The Author. 12°.

FOR a number of years the attention of geographers has been directed to improving the methods of teaching geography. This movement originated in Germany. Since the rapid growth of the science of geography, the necessity has been felt of including it in the course of studies of the universities. Towards 1870 professors of geography were appointed at various universities, and at present it is taught at all the great German universities. Most of the students who studied geography became, in course of time, teachers at higher schools; and thus a class of educationists, well versed in the science of geography, grew up, and to these we owe the fun-

damental reform of the methods of teaching geography. Most of the scientists who were appointed professors were originally not well acquainted with the needs of the Gymnasium and of other higher schools. They were so much engrossed by their subject as to be too exacting in their demands upon the pupil. These excessive demands, however, found their corrective when their students became experienced teachers. Thus the methods of teaching geography, after about twenty years of discussion, have been established on a firm and sound basis.

While material progress was thus being made in Germany, England and America had not even made the slightest attempt to bring about the much-needed improvement in the teaching of geography. A few years ago the attention of the Royal Geographical Society was called to this subject, and a thorough study of the methods used on the continent, particularly in Germany, was published. Here, also, the movement began among scientists, not among teachers; and therefore we observe again that too much was asked for. Since that time the movement has reached the schools, and innumerable attempts have been made to find a 'royal road' to the knowledge of geography. We may divide these into two classes: the first embracing suggestions of geographers or geologists; the second, those of teachers. While among the first class we find highly suggestive books which show that geography might be made the foundation of teaching natural science, they are deficient in not being written by experienced teachers. The second class shows the sad lack of trained teachers of geography, and the necessity that a reform of the teaching of geography must begin with training teachers.

Recently a number of valuable books have been published in England, but in America little has been done. Text-book after text-book and map after map are being published, but the new ones are in no way superior to the preceding ones. Since Guyot imported Ritter's ideas of geography into this country, the study has continued to move on this line, wherever it was more than mere memorizing of names. That geography which has recently developed in Europe has not reached our continent; the tendency here being to cultivate all the sciences contiguous to geography, while the complex geographical phenomenon does not attract the attention of the American scientist.

It seems to us that Parker's book marks a new step in the development of geography in our country. It is the first time that a leading educationist tries to solve the question how to study geography, and gives it its proper place in the course of study. Although not a geographer himself, and although a number of his statements are not in correspondence with the views held by geographers nowadays, he has a true conception of the ultimate aim of geography. "The study of geography, elementary and scientific, cultivates systematically the faculty of imagination, and the products of this faculty arouse and develop at every step emotions of beauty that culminate in the emotion of grandeur. The mentally pictured hill is 'a thing of beauty,' which, in time, towers up into the grand image of the lofty mountain. The lake is the inception of a picture of 'old ocean's solitary waste.' Gradually, under skilful teaching, hills, mountains, and plains, oceans and continents, are united in one sublime image of the round world. Life-bearing and life-giving, it stands out before the exalted imagination." This view is fundamental in giving geography its proper place in school and in life. It is not the sole object of geography to analyze observations, and thus to train the mental power of the child, although it is well adapted to this purpose: its more important function is to train the imagination and the power of feeling, to bring home the grand truth of the unity of nature.

This being the concept of the book, Parker omits physiography, which is the favorite subject of many writers of school-geographies, altogether, and defines geography as purely and simply a description of the earth's surface; and the primary purpose of teaching geography, to develop in the pupil's mind a concept corresponding to the earth's surface.

The book opens with a general introduction on the aim and scope of teaching geography. This is followed by a chapter intended to aid teachers in laying out their plans for teaching. The third part is an outline of a course of study of elementary geography, which is followed by very interesting directions and suggestions. The rest of the book is taken up by notes on the course of study. We do not intend to enter into the details of this plan, but confine ourselves to a few remarks. Parker's directions on the use of maps ought to be read and borne in mind by every teacher. There are very few persons who are able to interpret a map; and teachers ought to bear in mind constantly the fact that the map only represents part of the earth's surface, and that its object in teaching is exclusively to convey the concept corresponding to the country it represents. In order to reach this end, Parker strongly advocates moulding and the use of relief-maps, although he is aware of the serious objections raised to this method. Until better school-maps are provided, it will be impossible to dispense with this means of teaching.

The course of study which he recommends begins, of course, with systematic observations of nature, of the surroundings of the child. Thus the concepts of the natural features and elements of land and water are gained; and, these once obtained, he rightly turns at once to considering the widest generalizations, the continents, and works the detail into their general outline. It may seem doubtful whether his widest generalizations, slopes and river-basins, are the best from a geographical point of view. He considers the continents as formed of a short and long slope, and next subdivides the slopes and adds the necessary detail. This method fails in the case of Africa, and seems undesirable in teaching the geography of North America and Asia and their large plateaus. But Parker himself does not consider the course suggested in his book as final. There will probably be much discussion regarding detail, and on the important question, 'In how far, if the principal generalizations are derived from form, should the origin and development of that form be considered?' But a careful study of this important book will not fail to exert a most wholesome influence upon the progress of geography in our schools, and it may be that it will open the road to that science of geography which has so far hardly any representatives in America.

The History of Protective Tariff Laws. By R. W. THOMPSON. Chicago, R. S. Peale & Co.

THIS book is not to be taken seriously as a history of the tariff. Of independent or original historical investigation there is hardly a trace. There is nowhere any reference to the author's source of information; nor, indeed, is this necessary for the sort of information he gives. We are told in the volume chiefly about the opinions which various statesmen have held at one time or another on the tariff, — the sort of historical knowledge which can be got readily enough by glancing through files of presidential messages and of the congressional debates. Even this information, whose value is dubious enough at best, is distorted and worthless. One would imagine, from Mr. Thompson's quotations and copious Italics, that all the statesmen we ever had were the stiffest of protectionists. Of other information there is very little. Various tariff acts are described in the vaguest way, so that the reader is unable to guess what the general range of duties under them was, still less what was the duty on any particular article. There is no pretence of investigation of economic history, of the development of protected industries, of the difficult and perhaps insoluble problem as to the effect of protective duties on general prosperity.

In fact, Mr. Thompson writes, not a history, but a voluminous campaign pamphlet. That he has a strong bias (to put it mildly) for protection, is not inconsistent with his doing good historical work, even though not the best. But he has done no such work, and the student of history will turn over his chapters with a sigh of disappointment. Nor will the book appeal to those who want solid and serious argument on the tariff controversy. The reasoning is of the most watery sort, and consists chiefly of vague paragraphs on industrial independence, the home market, the disastrous effects of importing more than we export, the designs of England, and what not. Only those who want campaign thunder would find any thing to their purpose; and they are not the sort to wade through 526 pages, when they can get their thunder in compact form, and gratis, from campaign committees. Mr. Thompson's history belongs to that class of books by public men which are bought for their title and their large print by respectable philistine families, and repose unread on scanty book-shelves.

History, at its best, cannot help us much in the tariff controversy. The crucial question as to the effect of protective duties on general prosperity eludes a specific answer. The tariff is but one of a thousand factors affecting the country's welfare, and by no means among the most important. Its effects are so covered and hidden by the effects of other causes, that it is practically impossible to follow them out to their end. There is no subject on which so much unwarranted nonsense is talked, on both sides, as on the question of protection. He who approaches it with so cock-sure an air as Mr. Thompson, and tells us glibly about the beneficent effect every high tariff has exercised, and about "the general embarrassment" which followed low duties, is, on the face of it, incompetent to tell us any thing worth listening to.

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NOTES AND NEWS.

THE third number of the *Internationales Archiv für Ethnologie* is full of interesting material. The journal has rapidly become the principal source of information to those whose studies refer to ethnological collections. Each number contains beautifully engraved color-plates showing interesting specimens. The text gives elaborate descriptions of these plates, and reports of numerous museums; descriptions of important accessions, of the organization of the collections, and information regarding smaller collections, which would otherwise be inaccessible to the student. The last number contains a description of the extensive collection made by Adrian Jacobsen among the Golds and Gilyaks, and a description of the native tribes of Liberia. Besides this, it contains interesting reports of current literature, recent explorations, and new collections.

— The second annual meeting of the Iowa Association for Scientific Research was held at Des Moines, Io., Sept. 5 and 6. Among the papers presented were, 'Local Problems in Science' (presidential address), by Herbert Osborn; 'My Experience in rearing *Vanessa antiopa*,' by F. M. Witter; 'On the Sedentary Habits of *Platyceras*,' by Charles R. Keyes; 'On the Folding of Carboniferous Strata in South-western Iowa,' by J. E. Todd; 'Descriptions of New *Cynipidæ*,' by B. T. Gillette; 'The Pustulate *Unionidæ*,' by R. Ellsworth Call; 'The Fauna of the Lower Coal-Measures at Des Moines, Io.,' by Charles R. Keyes; 'The *Cicadidæ* of Iowa,' by Herbert Osborn; 'The Lineage of Lake Agassiz,' by J. E. Todd; 'From the Stamen-Petal,' by B. D. Halsted; 'Some Additional Observations on the Loess in and about Muscatine,' by F. M. Witter; 'The Geology of Crowley's Ridge, Arkansas,' by R. Ellsworth Call; 'On the Glacial Drift and Loess of a Portion of the North-Central Basin of Iowa,' by Clement L. Webster; and 'Descriptions of Two New Fossils from the Devonian of Iowa,' by Charles R. Keyes.

— An Italian engineer, M. Bocca, has just finished estimates for a ship-canal to cross Italy. The canal would start from Castro on the Mediterranean Sea, and end at Fano on the Adriatic. The length would be 282 kilometres, the width 100 metres, and the depth 12 metres, allowing large ironclads to pass. The canal would drain Lakes Perugia and Bolsena, and would allow of a systematic irrigation of that whole region. The cost is estimated at $100,000,000. The work would occupy 200,000 men for five years.

— Dr. M. Eschenhagen, in a recent number of *Petermann's Mitteilungen*, calls attention to an attempt to explain the magnetic polarity of the earth and the situation of the magnetic poles. The theory was first propounded by Dr. Menzzer. He assumes that electrical currents flowing from east to west cause the magnetic polarity of the earth. If the surface of the earth were solid, these currents which depend upon the rotation of the earth would run exactly east by west. This is approximately the case in the strata lying below the average depth of the ocean. In the highest layers, however, the distribution of land and water affects these currents. When entering the ocean, they cause a locomotion of the water, and thus the geographical features of the earth's surface affect the polarity of the globe. Eschenhagen shows by a simple construction what this effect would be on the southern hemisphere. He assumes that there are no electrical currents whatever in the ocean, and computes the influence of those of the continents according to the size, shape, and position of the latter. The result of this computation shows that the magnetic pole would be situated in latitude 76° 50′ south, and longitude 183°48′. According to Ross, its position is latitude 75° 6′ south, and longitude 171° 50′. As the influence of the Antarctic continent has not been included in this computation, the result must be considered very satisfactory and encouraging to further work on Menzzer's hypothesis.

— The *Political Science Quarterly* for September contains three articles on constitutional questions, the most important of them being that by Sydney G. Fisher on the 'Suspension of *Habeas Corpus* during the War of the Rebellion.' Mr. Fisher reviews the action of President Lincoln in suspending the *habeas corpus* by his own fiat, and, after considering the arguments on both sides, comes to the conclusion that such action by the executive authority was wholly unwarranted. The Constitution, in his opinion, gives the power to suspend the writ to Congress, and not to the President, and with this opinion we cordially agree. The subject is one of great importance, and it is unfortunate that the Supreme Court has never had the opportunity of passing judgment upon it, so as to settle the question authoritatively. Mr. William A. Dunning has a somewhat rambling article on the 'Inequality of the States,' in which he expresses the opinion, that, owing to certain conditions imposed by Congress at the time of reconstruction, some of the Southern States are not on an equality with their sisters. Mr. Dougherty's paper, on the 'Constitutions of the State of New York,' is the first of a series, and will interest the people of the State, and students of institutions elsewhere. Prof. R. M. Smith concludes his discussion of the immigration question, expressing himself strongly in favor of restriction; yet he has little to propose in the way of restrictive measures beyond the more rigid enforcement of existing laws. The article in the *Quarterly* that will be likely to attract most attention is the opening one, by George Gunton, on the 'Economic and Social Aspect of Trusts,' in which he takes the ground that these colossal combinations of capital "are the natural consequence of modern industrial differentiation, and in their nature are economically wholesome, and politically and socially harmless." He confines himself mainly to the economic aspect of the subject, and overlooks some important facts connected with it; but his essay will be useful as a corrective of extravagant and unintelligent views on the other side of the question. On the whole, this number of the *Quarterly* is one of the best that has yet appeared.

— Harper & Brothers have in preparation Sir J. W. Dawson's 'Modern Science in Bible Lands.' —— E. & F. N. Spon have now ready the third edition of 'Dynamo-Electric Machinery: a Manual for Students of Electrotechnics,' by Silvanus P. Thompson. Most of this treatise has been re-written for this edition, and much new matter has been added. The same firm announces as ready Sept. 1, 'The Elements of Electric Lighting,' including electric generation, measurement, storage, and distribution, by Philip Atkinson. They also publish 'Crystal Models,' by John Gorham, and the second edition of 'Short Lectures to Electrical Artisans,' being a course of experimental lectures delivered to a practical audience, by J. A. Fleming. —— The September issue of the *American Magazine* opens with an article on 'The American Navy of To-day,' by Lieut. William F. Fullam, U.S.N. A feature of the article is a description of Captain Zalinski's dynamite cruiser, the 'Vesuvius.' The new cruisers are fully described. —— With the issue of Aug. 30, *Light, Heat, and Power* becomes a weekly journal. —— The Electric Light Convention, just closed in New York, was the most largely attended meeting yet held by the association, and the papers, reports, discussions, and addresses were of unusual interest and importance. Although the business of the convention only came to a close late Friday afternoon, Aug. 31, *The Electrical World* was out on Saturday morning with its usual full, carefully prepared stenographic report of the proceedings. —— Dr. McCook's 'Tenants of an Old Farm' (New York, Fords, Howard, & Hulbert), published at $2.50, will be sold this season at $1.50.

LETTERS TO THE EDITOR.

Exploration of the Xingu.

THE German explorers, Karl and Wilhelm von den Steinen, embarked in Rio de Janeiro, July 21, for Germany, after nearly a year spent among the Indians of Matto Grosso. The exploration of the Xingu in 1884 by the two Von den Steinens and Claus revealed the fact that in this region exist a number of tribes who are not acquainted with the existence of a white race, and who may literally be said to represent the primitive condition of the Brazilian Indians in the stone age and before the discovery of America. Furthermore, the diversity in the language of these tribes indicates a variety of ethnological groups, and offers a rare opportunity for studying the apparently insoluble riddle of the natural classification of the Brazilian aborigines. The importance of the results of the 1884 expedition, and still more those that might be expected from future work in such a promising field, led Dr. Karl von den Steinen, after the publication of his book, to resolve upon a new exploration, in which he was warmly seconded by European ethnologists. The new expedition, unlike the first, which was organized mainly with a view to geographical work, came prepared to give chief prominence to ethnology. Dr. Karl von den Steinen, who proposed to devote his attention principally to language-work, was accompanied by his cousin Wilhelm, one of the original Xingu party, as artist; Dr. Paul Ehrenreich, who had already made important ethnological studies in Brazil, as assistant ethnologist and photographer; and Dr. Peter Vogel as geographer and geologist.

Leaving Rio de Janeiro in February of last year, the party was delayed in ascending the Paraguay by the existence of cholera along that river, until the beginning of June, the interval being employed in an examination of the shell-heaps of Santa Catharina. The president of Matto Grosso furnished an escort of four soldiers under command of an ensign. Another ensign, who had accompanied in part the 1884 expedition, and had since retired from the service, joined the expedition as a volunteer. A civilized Bakairi Indian, Antonio, also of the 1884 party, was engaged as interpreter, making up, with the necessary *camaradas*, a party of fourteen. The expedition left Cuyaba July 28, the explorers on foot, and serving as occasion required as *peones*, trail-cutters, and oarsmen. Proceeding first to the Paranatinga, an affluent of the Tapajos, for whose exploration a party of Brazilian engineers was lately fitted out, several astronomical determinations were made about the head waters of that river. The party then marched to the north-east, passed the Batovy branch of the Xingu, explored in 1884, and on the 7th of September reached the Kuliseu, where a permanent camp was made for a portion of the party, that remained in charge of the animals and baggage, while the explorers descended the river in bark canoes made on the spot, to the confluence of the Kuliseu with the Batovy. The first Indians met with belonged to the Bakairi tribe, with whom, as the language was already known, communication was readily made, and with whom the explorers spent several weeks, accompanying them on their fishing and hunting excursions, in their agricultural labors (performed entirely with stone and wooden implements), in their festivities, and, in fact, in all the phases of their life. The next and most numerous tribe was the Nahuqua, who, like the Bakairi, belong to the Carib family, which is supposed by Dr. von den Steinen to have migrated northward to the Caribbean Sea from some point in Central Brazil. The Nahuqua have a number of villages on the Kuliseu and on the Kuluene, the principal branch of the Xingu, with which the former unites. The sudden arrival of a large party so alarmed these people, that it became very difficult to study them, and in consequence Dr. von den Steinen resolved to make his entry alone, or with only a small number of Indian companions, in the villages of the other tribes, in order to establish friendly relations before the arrival of the full party. This somewhat hazardous experiment was tried first with two completely savage Bakairi companions in a village of Mehinaku Indians, the only weapon carried being a revolver. The traveller was received by a tumultuous crowd of naked savages, shouting, brandishing bows and arrows, and beating their breasts, who seized him by the wrists, and with considerable violence led him to the central feast-house, where he was plumped down on a bench, and made the recipient of a shower of questions and of hospitable presents of cakes and porridge. A German speech and sundry recitations from Goethe, delivered with hearty laughter, were accepted as a reply to the unintelligible questions, and friendly relations were soon established.

Other tribes are the Auatihu, Vaura and Kustenau, Yaualapiti, Camaiura, and Trumai. The Camaiura are true Tupi, and manifested great satisfaction on hearing the common names of plants and animals that have been incorporated in Portuguese. The Trumai, by their language and physique, differ markedly from all the other tribes. They had been met with in 1884, but the accidental discharge of a gun so alarmed them that no communication could be established. After that, they suffered greatly from the attacks of the Suya, a Botocudo tribe living lower down the river, and, retreating southward, were naturally greatly alarmed on meeting again the strangers with the thundering arms of the former encounter.

Returning to Cuyaba near the end of December, the travellers had an opportunity for studying the Pareci, and afterwards made an excursion to the river Sao Lourenço to examine the Bororo or Coroado. The Von den Steinens then descended the Paraguay, and spent some time examining the Indian remains in that province. Dr. Ehrenreich proceeded to Goyaz to descend the Araguaya to Para; and Dr. Vogel remained behind to explore geographically the highlands between the Paraguay and Parana, with the especial object of opening a road from the colony of Sao Lourenço to Santa Anna do Paranahiba, on the Parana, which was successfully accomplished.

The scientific results of the expedition far exceeded the most sanguine expectations. In a lecture before the Geographical Society of Rio de Janeiro, Dr. Karl von den Steinen presented the following general observations on the Indians of the upper Xingu.

As a rule, they are of low stature, but well proportioned and agile, of light clay color, with black hair, which is wavy in some individuals. The women wear the hair hanging loose to the shoulders: the men cut it in a circle about the base of the skull, and in some tribes shave the crown of the head. All the hairs of the face, including the eyebrows, and of the body, are carefully pulled out. The Trumai are distinguished from the others by a weaker physique and more brutal physiognomy. The only clothing worn is a triangular *tanga* of palm-leaves, "bigger than the eye, but not so big as the ear," used by the women. The body is smeared with coal-dust or oil colored with annatto. The houses, round or elliptical and high and airy, are generally built in a circle about a central feast-house, which is uninhabited, and into which the women are not permitted to enter. As a better safeguard against feminine curiosity, the entrance to this house is a mere hole less than a metre high. This structure is also used as a guest-house. The usual habitations serve for several families; the hammocks of palm-fibre, or cotton woven by hand between two stakes driven in the ground, being hung from a post in the centre to the sides. Each house has several fireplaces, and care is taken to keep the fire alive during the night to avoid the troublesome process of producing it by stick-rubbing.

Agriculture and fishing furnish the principal means of sustenance. The chase is comparatively unimportant. Dogs are unknown, and domesticated animals are limited to a few birds, principally of the parrot tribe. Corn, cotton, tobacco, sweet-potatoes and other tubers, are cultivated. Rice, cane, mandioca, and the banana are unknown. The plantations are of considerable extent, and compare favorably with those of the whites of Matto Grosso. The forest is cleared by the use of polished stone axes about the size of the fist, fixed in a wooden handle. The teeth of certain fishes serve for knives, and river shells as scrapers for working in wood. For hoes or ploughs, pointed sticks and the claws of the giant armadillo are used. The stones preferred for axes come from stream-beds in the possession of a single tribe. The commercial relations, however, are limited to an exchange of presents without idea of relative values. In the first trade made with the explorers, for an axe, a large canoe, which had to be carried for two leagues on the shoulders of six men, was gladly given in exchange. On another occasion a basket of fruit gathered in the presence of the party was offered for the same coveted instrument.

Another object of Indian barter is pottery, made only by the

women of certain tribes, all of which belong to the Nu-Aruak stock. Tattooing is also limited to the ceramic tribes. The most perfect objects of their industry are the masks used in dancing. The Tupi tribes make them of painted fabrics; the others, of wood, with large noses and small openings for the eyes, ornamented with a symmetrical design of the face.

In general, only the men take part in the dances, ornamented with feathers, and with the body enveloped in cloaks of palm-fibre. The step is marked by the shaking of a rattle, and the dance is accompanied by songs containing ancient words, some of which are evidently unintelligible to the Indians themselves. The only other musical instrument is the flute of one or three tubes, and of all sizes, from very small ones up to those in which the larger tube is as high as a man. In the dances great use is made of bows and arrows, and, in the Tupi tribes, of a peculiar form of arrow, shot, not from a bow, but from a throwing-stick held in the hand. The dances are held within or in front of the feast-house, called the 'flute-house.' It is believed that any woman who should venture to enter this house would die. In other respects, however, the position of the woman is not so inferior as is generally supposed. Although her position may be that of a servant, she knows, like her civilized sisters, how to obtain a fair share in the government. They are devoted mothers, though the children are held to have more intimate relations with the father, from whom they are supposed to derive body and soul, than with the mother. Parentage, however, is traced through the mother. On the occasion of a birth, the father remains for several days in his hammock on a diet of water and porridge. Marriage is monogamous, and is effected by the bridegroom taking his chosen bride to his lodge and hanging his hammock over hers.

The dead are buried in front of the feast-house, with the head to the east, holes or canals being made to facilitate the entrance of ants and other insects. The belief in a continuation of life after death is general. In dreams the soul is believed to leave the body and wander in the places dreamed of; and it is recommended not to awaken a sleeper suddenly, for fear the time may not be given for the return of the soul. They have many legends of their ancestors, which pass from generation to generation, and appear to contain many antiquated words. The idea of a personal God is unknown. The *pagés* pretend to control the storms, and all cases of illness or death are attributed to them. They are also the physicians, the treatment consisting principally in blowing tobacco-smoke on the patient. The blowing of smoke in the ears of guests is also a sign of friendship, and the latter are invited to moisten the ears of their hearers with spittle in order to be more clearly understood. The *pagés* appear to enjoy as much respect as the chiefs. The authority of the latter, unless it be in war, is not great. Dissatisfaction with the government is expressed by a migration in a body from the village, leaving the government to itself.

The number of Indians on the Batovy and Kuliseu is estimated at more than three thousand. Before returning, the explorers distributed among them their stores, including over fourteen hundred knives, so that the future traveller in this region will no longer find the stone age. ORVILLE A. DERBY.

Rio de Janeiro, July 26.

Proceedings of the Society for Psychical Research.

IN a notice of the Proceedings of the English Society for Psychical Research which appeared in *Science* for July 20, a sentence occurs which may, I think, mislead your readers on a rather important point. The writer refers to the statement in the Proceedings, that certain girls, from whom experimental evidence of telepathy had been gained, were afterwards detected in the use of a code of signals; and he goes on to say, "If scientific observers can thus be deceived by young girls, . . . ought not this to impress upon every investigator the profound importance of acquainting himself with the possibilities of deception?" Your readers will probably infer from this that the experiments in which signalling was detected were carried on under conditions which the investigators in question had erroneously regarded as excluding the possibility of deception. This inference, however, would be altogether mistaken: the view which the investigators took of these experiments was that expressed in 'Phantasms of the living' (chap. ii. p. 22), as regards earlier experiments of the same kind.

"Still such simple objects would not demand an elaborate code for their description; nor were any effective means taken to block the percipient's channels of sense. . . . We could not, therefore, regard the testimony of the investigators present as adding much weight to the experiments in which any members of the family were among the group of agents, unless the percipient was completely isolated from that group."

As is explained in the passage of the Proceedings to which your reviewer refers, the experiments in which signalling was detected were merely interludes among other experiments conducted under more stringent conditions, which were complete failures.

FREDERIC W. H. MYERS.

Cambridge, Eng., Aug. 24.

Effigy Mounds in Northern Illinois.

THAT imitative or 'effigy' mounds are to be found in northern and north-western Illinois has been asserted from time to time in works treating of the remains of the mound-builders; but no one seems hitherto to have gone to any great trouble to prove the fact, much less to accurately survey, map, and publish specimens of them — at least, not so far as I have been able to find out.

Mr. Lapham, in his well-known work 'Antiquities of Wisconsin' (1855), mentions mounds of the 'turtle' form on Rock River as far south as Rockford, and others on Apple River in Illinois, a few miles south of the State line of Wisconsin.

In the fifth volume of the 'Geological Survey of Illinois,' A. H. Worthen, director (1873), especial mention is made of ancient mounds at Rockford and in its vicinity, particularly the one known as the 'Turtle Mound.' He says it resembles an alligator with its head cut off more than it does a turtle.

The above is all the information I have been able to find in print on the subject, though possibly there may have been minor articles in newspapers or other periodicals, now as completely lost as the proverbial needle in the haystack.

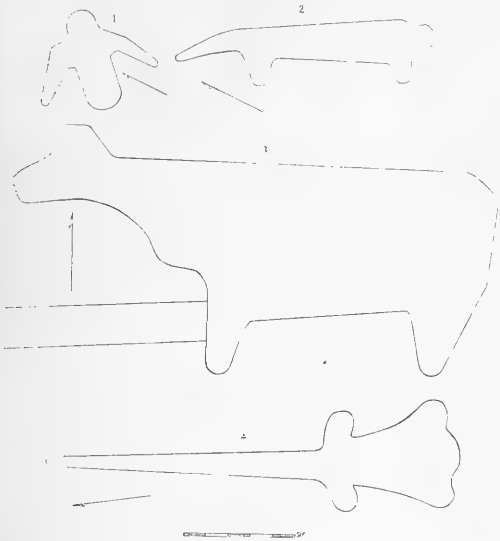
In a tour I made this spring in the region treated of, I looked for mounds of this class, and found them scattered at intervals along the Rock River valley, and also at points to the westward. I surveyed some of the best preserved of them, and here give succinct descriptions of four, which all differ from each other in shape, with necessary illustrative diagrams exactly drawn to scale from my field-notes.

The so-called 'Rockford Turtle' (1) in Winnebago County is situated between Main Street and Rock River, four blocks north of State Street, in the city of Rockford. It is 184½ feet long from the tip of its tail to the centre of the farther end, where a head should be, according to our ideas. It is three feet high at the junction of the hind-legs with the body, at the junction of the fore-legs and body the average height is 4 feet, but from the bottom of a slight swale that passes the head the height is 5½ feet. In connection with this effigy there is a bird (with one wing demolished), seven round mounds, and two embankments. These mounds are located on the most beautiful spot in the city, and, with one exception, have been well preserved by the owners of the land.

The bird-effigy (2) is on the east side of Rock River, some five miles below Rockford, on the N.W. ¼ of Sec. 14, T. 43, R. 1, E., in Winnebago County also. Its length from top of head to end of tail is 45½ feet; and from tip to tip of wings, following the centres, it is 68 feet. The height at the junction of the wings and body is 2 feet. While this is unquestionably intended to represent a bird, yet it is impossible to give it a closer classification. With it there are three embankments and two round mounds. The group is situated on a high bank some 45 feet above the river, and commands a fine view.

The animal (3) is on the N.W. ¼ of Sec. 22, T. 26, R. 2, E., some two miles below the village of Hanover, in Jo Daviess County, and on the east side of Apple River. Its greatest length in an air line is 216 feet, and the average height of the body 5½ feet. The body and head are on nearly level ground, while the legs run down the slope. The fore-leg rests on the end of an embankment which is 170 feet long and 1 foot high. From the general appearance at the

connecting point, it is very evident that the animal was constructed last. This overlapping of mounds is by no means uncommon in the North-West, and probably may account for the 'amalgamation mounds' of some writers. Besides the animal, there are in the same group twenty-three round mounds and ten embankments, as well as four other round mounds which have 'approaches,' or a low embankment, running from each.



A much less bulky animal (4) is on the S.E. $\frac{1}{4}$ of Sec. 13, T. 27, R. 9, E., some ten miles east of Freeport, Stephenson County, and on the north side of Pecatonica River. Its greatest length in an air line is $116\frac{1}{2}$ feet, and the average height of the body $1\frac{1}{2}$ feet. In the same group with it there is one embankment and seven round mounds, three of which are partially demolished. In one of the latter a fine hematite 'plumb-bob' was unearthed, in connection with a human skeleton which was badly decayed. Hematite relics in this region, and especially plumb-bobs, are exceedingly rare.

Near these mounds, but at the foot of the slope, there is a fine boiling spring of pure cold water.

Very few of these Illinois effigy mounds are in a good state of preservation; but I looked around long enough to find ten of them worth surveying, of which the four now given are the best suited for publication as types.

In surveying mounds of this class it has been a special object to get their true outlines as near as possible, without any preconceived ideas or fanciful imaginings as to what animal or other object they were intended to represent. To do this it is necessary to determine where the artificial ground ends on the natural surface. It is hardly possible, however, for the reader, even with the aid of faithful diagrams, to form an adequate idea of the beauty and symmetry of the effigies as they appear to the eye when in their undisturbed state. T. H. LEWIS.

St. Paul, Minn., July 31.

The Coal-Measures of Kansas.

THE drilling of a 2,000-foot well at Emporia, Kan., has furnished an excellent section of the coal-measures of this State. The location of the section, unfortunately, can be given but approximately. Beginning somewhere in the upper half of the upper coal-measures, it ends in the lower third of the lower coal-measures. The section is very interesting, however, independently of its position in the formations.

In the depth of nearly 2,000 feet there are 112 strata with an average thickness of nearly 18 feet. Of these strata, 50 are shale, 50 limestone, and 12 sandstone. The limestone strata average $9\frac{1}{4}$ feet in thickness; the shale, 25 feet; and the sandstone, 24 feet. In the upper thousand feet are $\frac{3}{4}$ of the shale strata, $\frac{7}{16}$ of the limestone, and $\frac{5}{12}$ of the sandstone strata; but in the first thousand feet are $\frac{7}{12}$ of the shale, nearly $\frac{1}{2}$ of the limestone, and $\frac{1}{4}$ of the sandstone. The total thickness of the shale is 1,242 feet, limestone 465 feet, and sandstone 286 feet. Mingled with the shale are three beds of coal in the first 500 feet, and one bed in the last 500. The thicknesses average less than one foot.

The section teaches that the conditions under which the coal-measures were deposited were exceedingly variable, and that the tracing of the strata through eastern Kansas will not be a holiday task.

These deposits, even including the limestone, are mostly shallow-water accumulations, and are quite rich in fossils, especially the limestone. Incrusting corals, crinoid joints, and brachiopod and conchifer shells are especially abundant. Trilobites are rare.

L. C. WOOSTER.

Eureka, Kan., Aug. 31.

Radiant Energy.

IN your issue, Aug. 17, Prof. S. P. Langley, in his presidential address at the late meeting of the American Association for the Advancement of Science, puts his case a little too strongly in favor of Draper, I think, when referring to Melloni's statement of the relation between light and heat forms of radiant energy, made in 1843. He says, —

"So far as I know, no physicist of eminence re-asserted Melloni's principle till J. W. Draper, in 1872. Only sixteen years ago, or in 1872, it was almost universally believed that there were three different entities in the spectrum, represented by actinic, luminous, and thermal rays."

As a student at Dalhousie University, Halifax, Nova Scotia, before Draper's publication of 1872, I found Melloni's principle not only "re-asserted," but accepted. I fail to understand how it could be otherwise in the United States, when Tyndall's lectures and demonstrations in the Royal Institution were published in 1863, a quarter of a century ago; when the Smithsonian Report of 1868, twenty years ago, published Tyndall's Rede Lecture before the University of Cambridge in 1865, with translations of articles by Cazin and Magrini bearing on the same subject. But, more than that, Tyndall's lectures were published in a neat volume of some five or six hundred pages, by D. Appleton & Co. of New York, in 1870, two years before Draper's publication. I thought Professor Langley might have eminent "American physicists" in his mind; but his reference to the English cyclopædia of 1867 immediately before, suggests no such limit to his statement. A. H. MACKAY.

Pictou Academy, Nova Scotia, Aug. 22.

[Mr. MacKay's letter may elicit more information on an interesting point, but attention should be drawn to the fact that he offers no evidence (i.e., cites no passages) to show that the lectures he mentions *do* quote any "physicist of eminence" in plain support of the doctrine in question. A statement as explicit as Melloni's or Draper's is what is wanted. Statements which might mean this (or any thing else) are plenty. —ED.]

The Laws of Corrasion.

UPON opening my copy of *Science* this morning, I am greeted with your note on Major Powell's "first formal announcement of a new law in the hydraulics of rivers" upon the relation between their corrading power and sedimentary load. I think you will find this principle fully stated by Major Powell in his 'Report on the Geology of the Uinta Mountains' (Government Printing-Office, 1876); but my object in writing is to draw your attention to the recognition of this "new law" in Chapter XVI., and especially p. 226, of the new 'Physical Geography' of Van Antwerp, Bragg, & Co. The law as enunciated in the first paragraph of *Science* (No. 290) is only true within certain limits, for the sedimentary load of a stream may become so great that it requires all the energy of the current to simply transport it, and hence there is little or no corrasion. The rivers of the Great Plains, — as Platte, Republican, Arkansas,

Red, etc., — which have a steep declivity, but flow in broad, shallow valleys, are examples.

This matter is fully discussed by Powell in the report above cited (1876), and by Gilbert in his report on the Henry Mountains (1880). RUSSELL HINMAN.

Cincinnati, O., Aug. 27.

[Our esteemed correspondent misapprehends the scope and specific limitations of this "new law in the hydraulics of rivers," as he also does those of the law announced by Major Powell in his report on the Uinta Mountains, in 1876. In neither case is the law stated as a general one. Major Powell has never said, and does not now say, that in *all* rivers, and under *all* circumstances, "corrasion of every kind is increased by increase of load," although it may be true. But that is what our correspondent seems to suppose Major Powell's law of 1876 meant. Stated in its simplest form, the law of 1876 is as follows: "*In a region of degradation, vertical* corrasion is increased by increase of load, *in a diminishing ratio.*" He never dreamed at that time that this law could be generalized, or even that any similar law would explain lateral corrasion by a river flowing through a flood-plain. The new law which he now proposes as the result of subsequent study is, "*In a region of sedimentation* [and it must be noted that the flood-plain of the Mississippi is a delta region, and therefore a region of sedimentation] an increase of load increases *lateral* corrasion *in a geometric ratio.*" We did not emphasize this distinction in the brief editorial reference which we made to Major Powell's paper, assuming that any reader who had given especial attention to the study of the hydraulics of rivers would make it for himself, certainly if he read Major Powell's paper printed in the same number of *Science*, and beginning on the same page with the editorial paragraph referring to it; for all others the law was stated in the least confusing, although perhaps not in the most comprehensive language. — ED.]

A Notable Evolution.

THE remarkable power of the catbird as a singer is known to all those who give it a safe and welcome retreat. Yet I find even such writers as Baird describing it after this manner: "An American bird of the thrush family, whose cry resembles the mewing of a cat." In reality it is the mocking-bird of the North, possessed of ability to sing whatever notes he hears. I have them so perfectly at home in my grounds, that their delicious music is heard at all hours of the day, and often in the middle of the night. It is very curious to hear one of them warble in a low key to himself what some other bird is singing loudly. A few days since I heard one mimic a red squirrel, and he did it to perfection. If he had not enjoyed the fun so well that he could not keep from hopping about, I should not have known which was squirrel.

I did not, however, intend, except incidentally, to write about the catbird, *Mimus Carolinensis*. It, however, makes it easier for us to conceive the possibility of an evolution of superior vocalization in his relatives, when we consider his masterly ability. What I wish to record is a remarkable development in the case of his cousin the common robin, or migratory thrush. Every one knows what a clumsy singer he is, having a rough, see-saw note, that he repeats with little variation. For some reason the other birds give him precedence in the morning song with which daylight is greeted about half-past three in June. The first note comes always from the east, — a faint, far-away cry; then another cry leaps out of a tree nearer you, and then another and another. So the wave of robin-melody moves westward, over the house and over the land, preceding the rising sun, probably from the Atlantic to the Pacific. This song is peculiarly adapted to constitute a matin cry, being clear, strong, and cordial. But it is not musical. In June of 1887, crossing one of my lawns, I heard a cry so peculiarly like articulation that I was startled: "Hear this birdie! Hear this birdie! Hear this pretty birdie!" the last notes being exquisitely rendered, with a wave and upward bend. I had never heard such a song before, and imagined a new species of bird must have arrived; but after careful examination, I found the singer to be a veritable robin-edbreast, and not a new-comer at all. The song was repeated all the summer, to the delight of myself and friends. Of course, I awaited the opening of spring with anxiety, to know if our birdie would return. Almost the first song of spring, sure enough, was one morning in April: "Hear this birdie! Hear this birdie!" But, better yet, it was apparent that the babes of this family were singing, not the old robin's see-saw, but the new song. And now about my place are three or four of our birdies. What was notable was not only the remarkable evolution of musical power, but a love for music; for our birdie, unlike the robins in general, sang all day, like the catbirds. I could hear one or more at almost any hour. This drew my attention to the cause of the unexpected variation. John Burroughs suggested that it might be the song taught to one that had been caged and afterwards escaped; but I am more inclined to think that it is a natural variation or evolution, and that the robin has great and undeveloped power. It is a phlegmatic bird, that takes the world easy, and is not likely to exert itself in new directions. The catbird is fond of notice, likes to be whistled to, and enjoys answering back. He is likely to develop all sorts of new vocal accomplishments. But the robin is really lazy, and does as little hard work as possible. His nest is a clumsy affair, a mere daub of mud and sticks. Why has he begun this new song? Is it from being so constantly with catbirds, grossbeaks, orioles, etc.? for my nine acres are the paradise of birds. They are covered with fruits, hedges, trees. I do not know, but believe, some such cause to be at the bottom of the affair, and that we may look for other developments quite as remarkable. Within the month of June, while driving about five miles from my home, I saw a robin sitting on a wayside fence, and singing a set of notes most charmingly unlike any thing I had ever heard; neither was it at all like our birdie. It was as complex as a catbird often sings, but not apparently imitative. This has led me to a very decided conviction that an evolution in robin-music is now going on, and that some very delightful results may be looked for. I shall be glad to get notes from observers in different parts of the country. Of this I am certain, that our common thrush has a vast vocal power undeveloped. Evolution with birds must move, as it has moved, in the line of music, plumage, and flight, and nest-building. Nothing in these directions need surprise us.

I subjoin a note taken from a paper published near New York City, over two hundred miles from here: "Thomas O'Donnell of Rondout has a robin which whistles like a mocking-bird. This is probably due to the fact that it was raised in company with a mocker. The robin whistles 'Johnny, get your Gun,' and 'Don't leave your Mother, Tom!' Its powers of mimicry are wonderful. In the early morning, when things are quiet, the whistle of the bird has been heard a quarter of a mile. One day recently a man went into a saloon over the door of which the robin hung. The bird gave a sharp, quick whistle, which a man across the way, seeing his friend enter the saloon, considered a call to get a free drink. The man who first entered the saloon denied having whistled, but he nevertheless stood treat." I am confirmed by such reports in the belief that we shall see a remarkable evolution of robin-music. Our homestead pet and universal favorite will then be all the more dear. E. P. POWELL.

Clinton, N.Y., Aug. 28.

Queries.

36. DOUBLE FRUIT. — Last May a gentleman brought into my office a peach-tree branch quite thickly covered with small green peaches, most of which were double; that is, consisted of two (in several cases three) peaches, more or less completely fused into one. Some of the members of these doublets were hardly distinguishable as such, except by the fact that they had two stones; while others were scarcely united, and a few were entirely distinct from each other, but had only a single stem. Later I learned of such peaches being common in two other widely separated localities in this State this year, but no one had ever seen them in any previous year. I have also a collection of ripe cherries doubled in a similar way, and gathered this year from a tree in this city. Is this a common phenomenon? What is the appearance of the flower which gives rise to this double fruit? J. L. H.

Louisville, Ky., Aug. 7.

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SCIENCE

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SCIENCE

FRIDAY, SEPTEMBER 14, 1888.

THE YELLOW-FEVER IN JACKSONVILLE, although of a mild type and attended by an unusually small mortality, has become epidemic there. The United States Marine Hospital Service, under the authority given it by the new quarantine law and previous acts of Congress, has undertaken to prevent the spread of the disease from the infected points in Florida to other cities of the country. It is certain that every person, and every article of clothing, baggage, or of any other description, that comes out of Jacksonville, is in danger of conveying the infection to points which it otherwise might not reach. This is Surgeon-General Hamilton's justification for his order forbidding any person, baggage, or mail-matter to pass the quarantine station at Waycross, Ga., which is so situated as to intercept all railway-passengers from Florida, if from an infected district, without a quarantine of ten days for persons and a thorough disinfection of all clothing, baggage, and mail-matter. This, of course, causes very great inconvenience to those people of Jacksonville who desire to leave the city for healthful points in the North; but Dr. Hamilton has provided a refugee-camp, where any person may spend the period of quarantine free of expense, and in as much comfort as it is possible to give under the circumstances. These are the precautions that have been taken to protect the sixty millions of the people of the United States from sickness and death. It is unfortunate for the comparative few who have to suffer by detention in Jacksonville and other infected points in Florida; but the fact that more than a month has passed since the disease first appeared in Jacksonville, Tampa, and other points in Florida, and that not an authentic case has yet been reported as having occurred this side of the government quarantine station, is more than an ample justification for every thing Surgeon-General Hamilton has done. It may be that the yellow-fever will yet be carried to points outside of Florida. The most careful precautions are necessarily imperfect: they may sometimes be evaded, in spite of the most vigilant watchfulness. But every day that the contagious disease is confined within its present limits shortens the time that its ravages can continue elsewhere before the autumn frosts cut it short in its destructive career, and saves precious lives that else might have been sacrificed. If Surgeon-General Hamilton should succeed in preventing the spread of the yellow-fever beyond Florida, he will have rendered a service to the country that can never be measured in money. He deserves the most cordial support, which he is receiving, not only from the government, but also from the public press and enlightened public sentiment throughout the country.

IN A RECENT NUMBER of *The Medical News* appeared a note from a correspondent whose professional eminence is an unqualified indorsement of the accuracy of his observation, in which he writes, "I have recently seen in the medical journals that Dugald Stewart was once asked what was the earliest thing he could remember. He said it was being left alone by his nurse in the cradle, and resolving to tell of her as soon as he could speak. This may have been copied as a joke; but it brings to my mind the following statement that I have made from time to time for many years, which has always been received with derision, but which is a perfectly distinct remembrance in my mind: I remember being jolted over the crossings in a baby-wagon by a nurse, and resolving to tell of her as soon as I could speak." In reading the above, it occurred to us that it would not be amiss to ask the writer how he knew that there was such a thing as speech, and that he would ever be able to exercise that faculty.

THE ATTENTION OF OUR READERS has already been called to the passage by the Legislature of New York of an act substituting death by electricity for that by hanging as a punishment for crime. It will be remembered that Dr. William A. Hammond regarded the change as an unwise one, and presented a paper to the Society of Medical Jurisprudence on the 'Superiority of Hanging as a Method of Execution.' The society concurred in the views therein expressed, and protested against the passage of the law. In the *Asclepiad*, Dr. B. W. Richardson agrees in the main with Dr. Hammond. He believes that death by hanging is painless, and that the "process of hanging looks brutal without actually being so." He is especially severe on those who advocate the change. He says, "In disgust at the foolish barbarism of the time which keeps up the crime of capital murder, the humanitarian fraternity, afraid to support the sound and logical policy of abolition of the extreme offence, tries to dally with reason and conscience by the attempt to divest execution of all pain and all terrors. Euthanasia for the worst of criminals, by the side of so-called natural but often most cruel death for the rest of mankind, is practically the proposition, — a proposition which carries with it its own condemnation." In regard to the practicability of the new law, he expresses a great deal of doubt. In some experiments on the application of the electric discharge for the painless extinction of the lives of animals to be used as food, this mode of death was found to be any thing but certain. Sheep stricken apparently into instant and irrevocable death by electricity, after a few minutes showed signs of life, and were despatched in the ordinary way by the knife; and a large dog perfectly unconscious, and to all appearance dead, from the stroke of a powerful battery, was submitted to a surgical operation during unconsciousness, and afterwards made a sound and easy recovery. In most cases the electric shock will kill at one discharge, but exceptionally it will simply stun, and may induce the semblance of death instead of the real event. Dr. Richardson thinks that it will be real humanity, therefore, for the authorities of New York to supplement death by electricity by a post-mortem examination of the victims, so that the execution may not be crowned by burying the victims alive.

ON THE ALLEGED MONGOLIAN AFFINITIES OF THE AMERICAN RACE.[1]

WERE the question I am about to discuss one of merely theoretical bearings, I should not approach it; but the widespread belief that the American tribes are genealogically connected with the Mongolians is constantly directing and coloring the studies of many Americanists, very much as did at one time the belief that the red men are the present representatives of the ten lost tribes of Israel. It is practically worth while, therefore, to examine the grounds on which the American race is classed by these anthropologists as a branch of the Mongolian, and to inquire whether the ancient culture of America betrayed any positive signs of Mongolian influence.

You will permit me to avoid the discussion as to what constitutes races in anthropology. To me they are zoological sub-species, marked by fixed and correlated characteristics, impressed so firmly that they have suffered no appreciable alteration within the historic period either through time or environment. In this sense, Blumen-

[1] Paper read by Daniel G. Brinton, M.D., before the American Association for the Advancement of Science, at its meeting in Cleveland, O., Aug. 15-22, 1888.

bach, in the last century, recognized five races, corresponding to the five great land-areas of the globe and to their characteristic faunal and floral centres. This division was an eminently scientific one, and still remains the most in accord with anatomical and linguistic research. About twenty years after the appearance of Blumenbach's work, however, the eminent naturalist Cuvier published his great work on 'The Animal Kingdom,' in which he rejected Blumenbach's classification, and proposed one dividing the human species into three races, — the white or Caucasian, the black or Ethiopian, and the yellow or Mongolian. In the latter he included the Malays and the American Indians.

This triple division has been very popular in France, and to some extent in other countries. It is not, and it was not in its inception, a scientific deduction from observed facts, but was a sort of *a priori* hypothesis based on the physiological theories of Bichat, and at a later day derived support from the philosophic dreams of Auguste Comte. Bichat, for instance, had recognized three fundamental physiological systems in man, — the vegetative or visceral, the osso-muscular, and the cerebro-spinal. The anthropologists, in turn, considered it a most happy thought to divide the human species into three races, each of which should show the predominance of one or other of these systems. Thus the black race was to show the predominance of the vegetative system; the yellow race, the osso-muscular system; the white race, the nervous system.[1] As Bichat had not discovered any more physiological systems, so there could be no more human races on the earth; and thus the sacred triplets of the Comtian philosophy could be vindicated.

How little value attaches to any such generalizations you will readily perceive, and you will be prepared, with me, to dismiss them all, and to turn to the facts of the case, inquiring whether there are any traits of the red race which justify their being called 'Mongolian' or 'Mongoloid.'

Such affinities have been asserted to exist in language, in culture, and in physical peculiarities, and I shall take these up *seriatim* for examination.

First, as to language.

The great Mongolian stock is divided into the southern branch, speaking monosyllabic, isolating languages, and the northern branch, whose dialects are polysyllabic and agglutinating. The latter are sometimes called Turanian or Ural-Altaic; and as they are geographically contiguous to the Eskimo, and almost to the Athabascan, we might reasonably expect the linguistic kinship, if any exists, to be shown in this branch of Mongol speech. Is such the case? Not in the least. To prove it, I think it enough to quote the positive statement of the best European authority on the Ural-Altaic languages, Dr. Heinrich Winkler. He emphatically says, that, in the present state of linguistic science, not only is there no connection apparent between any Ural-Altaic and any American language, but that such connection is shown to be highly improbable. The evidence is all the other way[2] (*Uralaltaische Völker und Sprachen*, p. 167).

I need not, therefore, delay over this part of my subject, but will proceed to inquire whether there are any American affinities to the monosyllabic, isolating languages of Asia.

There is one prominent example, which has often been put forward, of a supposed monosyllabic American language; and its relationship to the Chinese has frequently been asserted, — a relationship, it has been said, extending both to its vocabulary and its grammar. This is the Otomi, spoken in and near the valley of Mexico. It requires, however, but a brief analysis of the Otomi to see that it is not a monosyllabic language in the linguistic sense, and that in its sentence-building it is incorporative and polysynthetic, like the great majority of American tongues, and totally unlike the Chinese. I may refer to my own published study of the Otomi, and to that of the Count de Charencey, as proving what I say.

Some have thought that the Maya of Yucatan has in its vocabulary a certain number of Chinese elements; but all these can readily be explained on the doctrine of coincidences. The Mexican antiquary Mendoza has marshalled far more coincidences of like character and equal worth to show that the Nahuatl is an Aryan dialect descended from the Sanscrit. In fine, any, even the remotest, linguistic connection between American and Mongolian languages has yet to be shown; and any linguist who considers the radically diverse genius of the two groups of tongues will not expect to find such relationship.

I shall not detain you long with arguments touching supposed Mongolian elements of culture in ancient America. Any one at all intimately conversant with the progress of American archæology in the last twenty years must see how rapidly has grown the conviction that American culture was home-bred, to the manner born; that it was wholly indigenous and had borrowed nothing — nothing from either Europe, Asia, or Africa. The peculiarities of native American culture are typical, and extend throughout the continent. Mr. Lewis Morgan was perfectly right in the general outline of his theory to this effect, though, like all persons enamored of a theory he carried it too far.

This typical, racial American culture is as far as possible, in spirit and form, from the Mongolian. Compare the rich theology of Mexico or Peru with the barren myths of China. The theory of governments, the method of house-construction, the position of woman, the art of war, — are all equally diverse, equally un-Mongolian. It is useless to bring up single art-products or devices, such as the calendar, and lay stress on certain similarities. The doctrine of the parallelism of human development explains far more satisfactorily all these coincidences. The sooner that Americanists generally, and especially those in Europe, recognize the absolute autochthony of native American culture, the more valuable will their studies become.

It is no longer in season to quote the opinions of Alexander von Humboldt and his contemporaries on this subject, as I see in some recent works. The science of archæology has virtually come into being since they wrote, and we now know that the development of human culture is governed by laws with which they were unacquainted. Civilization sprang up in certain centres in both continents, widely remote from each other; but, as the conditions of its origin were everywhere the same, its early products were much alike.

It is evident from what I have said, that the asserted Mongolian or Mongoloid connection of the American race finds no support either from linguistics or the history of culture. If anywhere, it must be in physical resemblances. In fact, it has been mainly from these that the arguments have been drawn. Let us examine them.

Cuvier, who, as I have said, is responsible for the confusion of the American with the Mongolian race, based his racial scheme on the color of the skin, and included the American within the limits of the yellow race. Cuvier had seen very few pure Mongolians, and perhaps no pure-blooded Americans; otherwise he would not have maintained that the hue of the latter is yellow. Certainly it is not. You may call it reddish, or coppery, or cinnamon, or burnt sugar, but you cannot call it yellow. Some individuals or small tribes may approach the peculiar dusky olive of the Chinaman, but so do some of the European peoples of Aryan descent; and there are not wanting anthropologists who maintain that the Aryans are also Mongoloid. The one position is just as defensible as the other on the ground of color.

Several of the most prominent classifications of mankind are based upon the character of the hair; the three great divisions being, as you know, into the straight, the curly, and the woolly haired varieties. These external features of the hair depend upon the form of the individual hairs as seen in cross-section. The nearer this approaches a circle, the straighter is the hair. It is true that both Mongolians and Americans belong to the straight-haired varieties; but of the two, the American has the straightest hair, that whose cross-section comes nearest to a perfect circle. So that by all the rules of terminology and logic, if we are to call either branch a variation from the other, we should say that the Mongol is a variety of the American race, and call it 'Americanoid' instead of *vice versa*.

The color of the hair of the two races is, moreover, distinctly different. Although superficially both seem black, yet, observed

[1] See FOLEY, *Des Trois Grandes Races Humaines*, Paris, 1881.

[2] I do not think that the verbal coincidences pointed out by Petitot in his *Monographie des Déné Dindje*, and by Platzmann in his *Amerikanisch-Asiatische Etymologien*, merit serious consideration.

carefully by reflected light, it is seen that the ground-tone of the Mongolian is bluish, while that of the American is reddish.

Of positive cranial characteristics of the red race, I call attention to the interparietal bone (or *os Incæ*), which is found in its extreme development in the American, in its greatest rarity among the Mongolians; also to the form of the glabella, found most prominent in American crania, least prominent in Altaic or northern Mongoloid crania; and the peculiar American characteristics of the occipital bone, flattened externally, and internally presenting in nearly forty per cent of cases the 'Aymarian depression,' as it has been termed, instead of the internal occipital protuberance (HOVELACQUE et HERVÉ, *Anthropologie*, pp. 231, 234, 236).

The shape of the skull has been made another ground of race-distinction; and, although we have learned of late years that its value was greatly over-estimated by the earlier craniologists, we have also learned that in the average, and throughout large numbers of peoples, it is a most persistent characteristic, and one potently indicative of descent or relationship. Now, of all the peoples of the world, the Mongols, especially the Turanian branch, are the most brachycephalic; they have the roundest heads; and it is in a high degree noteworthy that precisely the American nation dwelling nearest to these, having undoubted contact with them for unnumbered generations, are long-headed, or dolichocephalic, in a marked degree. I mean the Eskimo, and I cannot but be surprised that such an eminent anthropologist as Virchow (in *Verhandlungen der Berliner Anthrop. Gesellschaft*, 1881–82), in spite of this anatomical fact, and in defiance of the linguistic evidence, should have repeated the assertion that the Eskimo are of Mongolian descent.

Throughout the American continent generally, the natives were not markedly brachycephalic. This was abundantly illustrated more than twenty years ago by the late Prof. James Aitkins Meigs, in his 'Observations on the Cranial Forms of the American Aborigines.' They certainly, in this respect, show no greater Mongoloid affinities than do their white successors on the soil of the United States.

If color, hair, and crania are thus shown to present such feeble similarities, what is it that has given rise to a notion of the Mongoloid origin of the American Indian? Is it the so-called Mongolian eye, the oblique eye, with a seeming droop at its inner canthus? Yes, a good deal has been made of this by certain writers, especially by travellers who are not anatomists. The distinguished ethnologist Topinard says the Chinese are very often found without it, and I can confirm this opinion by those I have seen in this country. It is, indeed, a slight deformity, affecting the skin of the eyebrow only, and is not at all infrequent in the white race. Surgeons know it under the name *epicanthus*, and, as with us it is considered a disfigurement, it is usually removed in infancy by a slight operation. In a few American tribes it is rather prevalent, but in most of the pure Indians I have seen, no trace of it was visible. It certainly does not rank as a racial characteristic.

The nasal index has been recommended by some anatomist as one of the most persistent and trustworthy of racial indications. The Mongolian origin of the red race derives faint support from this quarter. From the measurements given in the last edition of Topinard's work (*Elements d'Anthropologie*, p. 1003), the Mongolian index is 80, while that of the Eskimo and tribes of the United States and Canada, as far as observed, is 70, that of the average Parisian of to-day being 69 (omitting fractions). According to this test, the American is much closer to the white than to the yellow race.

Most of the writers (for instance, Avé-Lallemant, St. Hilaire, Peschel, and Virchow) who have argued for the Mongoloid character of the Americans have quoted some one tribe who, it is asserted, shows marked Chinese traits. This has especially been said of the natives of three localities, — the Eskimo, the tribes of the North Pacific coast, and the Botocudo of Brazil. So far as the last-mentioned are concerned, the Botocudo, any such similarity has been categorically denied by the latest and most scientific traveller who has visited them, Dr. Paul Ehrenreich. It is enough if I refer you to his paper in the *Zeitschrift für Ethnologie* for 1887, where he dismisses, I should say once for all, the notion of any such resemblance existing. I have already pointed out that the Eskimo are totally un-Mongolian in cranial shape, in nasal index, and in linguistic character. They do possess in some instances a general physiognomical similarity, and this is all; and this is not worth much as against the dissimilarities mentioned. The same is true of the differences and similarities of some tribes of the north-west coast. In estimating the value of any resemblances observed in this part of our continent, we should remember that we have sufficient evidence to believe that for many generations some slight intercourse has been going on between the adjacent mainlands and islands of the two continents in the regions of their nearest proximity. The same train of events led to a blending of the negro and the white races along the shores of the Red Sea; but any one who recognizes the distinction of races at all — and I am aware that certain eccentric anthropologists do not — will not, on that account, claim that the white race is negroid. With just as little reason, it seems to me, has it been argued that the native Americans as a race are Mongoloid.

ON THE CAUSES OF VARIATION IN ORGANIC FORMS.[1]

THE fundamental principle of organic evolution is natural selection, which is based on individual variation and the struggle for existence, the effect of which is the preservation of the most competent. It is extremely difficult to get at the immediate cause or causes of this individual variation, and for this reason Darwin considered it promiscuous and aimless, though he wisely avoided calling it lawless. There is no more fascinating or profitable field of investigation than that leading to the proximate cause or causes of variation. We are not content to rest the case where Darwin did by recognizing variation as an inherent principle in organic forms, or to beg the question by saying that it is as much a necessity of life as natural selection itself. Let us, therefore, discuss these causes in the light of recent experience and experiment.

We soon find that they admit of a certain amount of classification, the minor divisions of which, as in all systems of classification, more or less fully interlock or blend. They fall, however, into two chief categories: viz., (1) external conditions or environment, which are, at bottom, physical; and (2) internal tendencies or promptings, which are, at bottom, psychical.

By external conditions or environment, we include all influences on organisms which act from without; and in carefully considering them we shall find it difficult to draw the line between those which are really external and independent of any motive or inherent tendency in the organism, and those which are not. Hence the general term 'external conditions' is resolvable into various minor factors.

No one can well study organic life, especially in its lower manifestations, without being impressed with the great power of the environment. Joseph LeConte speaks of the organic kingdom lying, as it were, "passive and plastic in the moulding hands of the environment." In Semper's 'Animal Life' we have the best systematized effort to bring together the direct causes of variation; and no one who has read through its pages can doubt the direct modifying influences of nutrition, light, temperature, water at rest and in motion, atmosphere still or in motion, etc., or question his conclusion that no power which is able to act only as a selective and not as a transforming influence can ever be exclusively put forth as a *causa efficiens* of the phenomena.

It is among the vital or organic conditions of variation that natural selection has fullest sway; and, as they have been so ably expounded by Darwin and others, I will at once pass to a consideration of the second class of causes, to which the study of the interaction of organisms leads, — the internal conditions.

First of these we will consider the physiological causes. Genesis itself is the first and most fundamental of all causes of variation. The philosophy of sex may, indeed, be sought in this differentiation, as the accumulated qualities in separate entities, when suddenly conjoined or commingled, inevitably lead to aggregation and heterogeneity; in other words, to plasticity or capacity to vary. Genesis,

[1] Abstract of an address before the Section of Biology of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15–22, 1888, by C. V. Riley, vice-president of the section.

as a fundamental factor in evolution, may be more intelligently considered under some of its subordinate phases, as heredity, physiological selection, sexual selection, primogenital selection, sexual differentiation including philoprogeneity, hybridity, etc.

Heredity, as expounded by the ablest biologists and as exemplified in life, is a puissant factor in evolution, and, though essentially conservative, must, through the marvellous power of atavism, tend to increase individual variability.

Physiological selection, as suggested by Mr. Catchpool and as expounded by Romanes, is undoubtedly an important factor in evolution. Romanes believes that wherever there has been modification of the reproductive organs introducing incompatibility between two individuals, even where there has been no other change or variation, we have a valid cause of differentiation which in its consequences must be important. Compatibility or fertility between individuals is of the very essence of selection. Natural selection implies that this sexual divergence is subsequent to or coincident with divergences in other directions; physiological selection, that it antecedes them. This theory implies variation in the reproductive organs, or departure from the parental type, in at least two individuals of opposite sex simultaneously; and with this admission, for which we are justified in facts, physiological selection will preserve many peculiarities which need have no necessary connection with the exigencies of life.

Sexual selection may be said to act in two ways, — by conflict of the males for possession of the female, or by attractiveness; the former being most conspicuous among mammals, the latter among birds, and both coming conspicuously into play among insects. It is rather difficult to define the limit of sexual selection as a factor in evolution; but I would not confound it with another factor, not hitherto generally recognized, but which I think must be all-powerful, namely, sexual differentiation.

It seems evident that the mere differentiation of sex in itself has been an important element in variation. This principle elaborated by Brooks as a modification of the theory of pangenesis is a good one, and in the main the male may be said to be the more complex and to represent the progressive, and the female the more simple and to represent the conservative, element in nature. When the conditions of life are favorable, the female preponderates, and exercises a conservative influence. When the conditions are unfavorable, the males preponderate, and, with their greater tendency to vary, induce greater plasticity in the species, and hence greater power of adaptation. Sexual differentiation may, I think, be used to include many other variations and differentiations not otherwise satisfactorily accounted for, and to express the law of the interaction of the sexes upon one another, inducing great differentiation entirely apart from the struggle of the males for the possession of the females, or the struggle for existence.

Last of all I mention hybridity, which has been fully discussed by many, and by no one more ably than by Darwin himself.

Among the psychical conditions, the use and disuse of an organ and its effect upon the offspring of the individual is of prime importance. That functionally produced modifications are inherited was the great assumption upon which Lamarck founded his theory of evolution. Many able naturalists have insisted on it, and in my judgment there should no longer be any doubt whatever of the fact. The influence of emotion on the individual is closely connected with this category, as strong mental effort may be made to affect special parts of the body.

An interesting problem is the influence of the emotion of a mother on her offspring. It is still doubtful whether such influence really exists; but, this theory once established, its bearing on evolution as a prime cause of variation must at once be manifest; for it gives not only tangibility to the Lamarckian idea of desire influencing modification, but also a conception of how infinite mind in nature may act through the finite in directing such modification. In my judgment, this factor acts only when, from whatever cause, and particularly under the spur of necessity, the emotions are exceptionally intensified, or the desire strongly centred in some particular object.

These psychical factors which we have been considering are substantially Lamarckian; and in proportion as we consider them, and get to understand the other direct causes of variation, must we give importance to the ideas of Lamarck, and, conversely, less importance to the ideas of Darwin.

There are certain important laws which have influenced modification, but in no sense can be looked upon as causes of variation. They are laws or principles of evolution by which we may account for the formation of types, acting, just as natural selection does, in differentiating rather than in originating the variation. Acceleration and retardation belong to this class. This law is an attempt to give expression and form to a set of facts to which paleontology undoubtedly points, and which ontogeny substantiates; viz., that certain types may attain perfection in time, and then retrogress and finally become extinct, and that existing types which are dying out or degenerating exhibit ontogenically the culmination of force and complexity, followed by decadence, corresponding to the phylogenic history of the type. This law may, perhaps, be substantially stated in this wise: that certain groups acquire some characters rapidly, while corresponding groups acquire the same characters more slowly, or never acquire them at all; and this brings us to another important factor of evolution which serves to give force to the law. It is the acceleration by primogeniture which has been elaborated by Hubrecht. He shows, that, in organisms in which the reproductive period covers many years, accelerated development by primogeniture (i.e., as between the first-born and the last-born of any pair and of their posterity) will in time produce differentiation. The series of the first-born will in the course of time involve many generations at short distances from each other whereas the series of the last-born will, on the contrary, consist of a much smaller number of terms, each separated from its predecessor by a more considerable distance. Any tendency to variation from external or internal influences must needs find more numerous occasions to act in the series of the first-born, not only because these have a more composite ancestry, but because they necessarily become the most numerous.

We are thus led to what have been called 'saltations' in evolution. Although the history of paleontology has continually added to our knowledge of past forms, and helped to fill up many gaps in the evolutional series, and although during the last quarter of a century it has particularly vindicated Darwin's prophecy that many links would yet be found, the substantial truth remains, that gaps still occur, and that progress, so far as present knowledge indicates, has been made by occasional saltations. There have been, it would seem, periods of rapid movement, and of comparative repose, or re-adjustment of equilibrium. Cope concludes that "genera and higher categories have appeared in geologic history by more or less abrupt transitions or *expression-points*, rather than by uniform gradual successions."

The forces of nature are constant, but the phenomena induced are often paroxysmal. The progressive forces accumulate, while the conservative forces resist until at last resistance gives way with comparative suddenness. There is every reason to believe that the life-movement, in its ascending complexity, has shared this common law. How far the rhythmic tendency in the development of animal life may be explained by the rapid change of climate, by migration and the loss of record, or upon the general law that while there has been progress of the whole there has not necessarily been progress of every part, it would take us too far to discuss in this connection. I think we are safe in saying, however, that the facts justify belief that in the evolution of animal life, as in the evolution of every thing else, progress has often been made by waves.

Having thus considered some of the proximate causes of variation and some of the more general laws of evolution, we are naturally led, in conclusion, to consideration of original or infinite cause. Far be it from me to try your patience with any prolonged speculation upon the more profound problems of life and of futurity, which have been dealt with by able men of all times, and with such conflicting and varying results. I shall content myself, in closing, with a few words upon those themes which, as biologists, we cannot ignore, and to which the subjects we have been considering inevitably lead.

Mind as exhibited in organic evolution, however simple or complex may be its manifestations, is in essence one and the same force. There is an undoubted gradation from simple sensitiveness

and volition to the more complex instinctive and reasoning faculties of higher animals.

Where, then, shall we draw the line in the evolution of mind between the high degrees of consciousness in animals, and self-consciousness, which is believed to be a peculiarly human attribute, and at the foundation of all that constitutes con-science and makes him a moral and responsible being? The beginnings of self-consciousness are traceable in animals, since many of the phenomena of sexual selection and the well-known sense of shame in our domestic associates could scarcely have resulted without it; and it seems to me illogical to argue, as some of our best writers on evolution have done, that self-consciousness is an attribute that must have been breathed into man by special, supernatural act.

From the consideration of the general subject of mind in nature, we are brought inevitably to the question of design. There can be no doubt that the tendency of evolution has been to remove further and further the idea of an infinite first cause. The argument for design, however, as Asa Gray has so well set forth, rests on the fact that the designed and the contingent can never be accurately discriminated, and that limitation, in the very nature of the case, is inconceivable. It seems to me that the evidences of design in nature are so overwhelming that its advocates have an immense advantage over those who would discard it. A fortuitous cosmos is, to most persons, utterly inconceivable; yet there is no other alternative than a designed cosmos.

The most philosophic view is probably that which, while recognizing an intelligent creative power, or mind, which has worked and is yet working through ordained laws, yet leaves the detailed manifestations to secondary causes and finite action. Limiting conditions or laws, since law is but a limiting condition and nature an active power, may act together in producing secondary causes, but the great and infinite cause may be looked upon as that which upholds the universe.

I have ventured just within the question of design, because of the prevalent belief that evolution eliminates it from our conception, and because I have felt that as between the extreme schools the middle ground chosen by our late lamented Gray is far the more satisfactory and philosophical. On the other great question of what life is, or how it originated, I commend the candor of Marsh in closing his address as president of the association in 1877 with the words, "In this long history of life I have said nothing of what life is; and for the best of reasons, because I know nothing." The genesis or formation of individual life, in spite of saint and sage, is yet a mystery, and probably always will be.

All that evolution recognizes is the transmutability — the generic identity — of the forces of nature, which, in their aggregate action, may properly be defined as omnipresent energy. We know, as a matter of the simplest observation, that this combined force or energy is essential to the continuance of life, not only upon our planet, but, deductively, in the universe. We are justified in inferring that it is capable, under fit conditions, of originating life from what we know as non-living matter. Evolution, in fact, inevitably leads to the inference that vital force is transmutable into, and derivable from, physical and chemical force.

SCHOOL OF BIOLOGY, UNIVERSITY OF VIRGINIA.

THIS school is founded upon the gift of one hundred thousand dollars by the late Samuel Miller of Lynchburg, Va., who provided that the income from this fund should be expended for "the advancement of agriculture as a science and as a practical art by the instruction therein, and in the sciences connected therewith, of the youth of the country."

A part of the income is used to maintain the work in agricultural chemistry, carried on in connection with the chemical department of the university, under the direction of Professors Mallet and Dunnington.

The residue, and the larger portion of the income, is to be expended in promoting instruction and research in biology. One floor of the medical hall (42 by 42 feet) is now being fitted up for a biological laboratory, including, as in the annexed plan, a laboratory-room for students, a private laboratory for the professor, a photographic room, and storerooms.

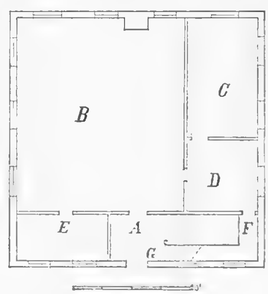
The equipment has already been ordered, and will consist of microscopes and dissecting-instruments for the students, microtomes, apparatus for staining and mounting preparations, photographic apparatus, instruments of precision for advanced researches, and a working library, and a file of periodical literature.

The instruction will be by lectures, with associated laboratory-

PROF. ALBERT H. TUTTLE OF THE UNIVERSITY OF VIRGINIA.

work, and will cover general biology, zoölogy and comparative anatomy, and biology applied to agriculture.

The professor-elect is Mr. Albert H. Tuttle, recently professor of biology in the Ohio State University at Columbus. He was born in Summit County, O., in 1844, was graduated from the State College of Pennsylvania, taught for two years (1868–70) in the First State Normal College of Wisconsin, was graduate student



PLAN OF BIOLOGICAL LABORATORY.

A, hall; *B*, student's laboratory (29' × 34'); *C*, private laboratory (12' 6" × 21'); *D*, photographic room (12' × 12' 6"); *E*, storeroom (8' 6" × 16'); *F*, closet; *G*, stairway to physiological room.

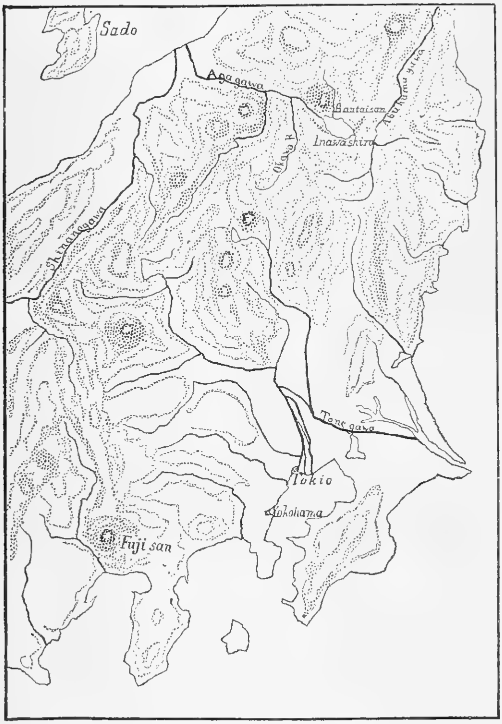
and instructor in microscopy in the Harvard Museum of Zoölogy under Professor Agassiz (1870–72), travelled and studied in Europe (1872–74), and was professor in Ohio State University (1874–88). During one year of this period he was absent on leave as graduate student in the biological laboratory of Johns Hopkins University.

In connection with the advanced work of agricultural students in chemistry and biology, Professors Dunnington and Tuttle will also conduct a small field-experiment station. On this the more hopeful lines of investigation into problems of practical agriculture will be carried out.

THE ERUPTION OF BANTAISAN.

ON the morning of July 15 occurred a phenomenon of such magnitude, and with results so serious, as to place it among the most remarkable events of volcanic origin of which record exists.

The place of eruption was the mountain of Bantaisan, situated about four miles and a half from Lake Inawashiro, and about a hundred miles directly north-west of Tokio, in latitude 37°36′ north and longitude 140°6′ east. The mountain is the terminal peak of a group of hills rising from an extensive plain, and attains an elevation of about 6,000 feet. Its summit is divided; and the lower or Sho-Bantaisan, with a height of about 5,000 feet, was the actual place of outburst.



The mountain is doubtless of volcanic origin, consisting largely of scoriaceous matter; mostly in a very much disintegrated condition, however. The immediate vicinity has, nevertheless, been the seat of active volcanic disturbance within historical times; though the great earthquake of 1611, and the formation of the lake near Banzai-ya in the location of a mountain which disappeared about 1760, are the most recent phenomena of the region distinctively volcanic in nature.

Bantaisan itself is supposed to have been formed in the year 807, as the result of an eruptive outburst; but there is no actual record of any period of volcanic activity, nor of any definite eruption, though the extinct crater is well defined, and ancient Japanese literature contains numerous allusions to the mountain as emitting flame and smoke.

This dearth of any actual record of eruption, taken together with the appearance of the mountain (which presents from the distance no evidence of former volcanic activity, and is clothed with verdure nearly to the very summit, oak-trees growing high up its sides, and only here and there showing projecting eruptive rock), leads to the inevitable conclusion that the mountain must have been free from actual eruptive phenomena for probably a thousand years. Indeed, one ancient writer asserts that Bantaisan ceased its existence as an active volcano with the origin of Lake Inawashiro.

Evidences of slumbering volcanic force remained, however, in the presence, at three different elevations on the mountain-sides, of extensive hot-springs, the visitors to which were among the chief sufferers from the calamity of July 15.

Premonitory symptoms of an unusual disturbance were first experienced on the 13th, and continued, in the shape of rumbling sounds and slight earthquake shocks, for two days and nights; yet the phenomena were not of such a nature as to cause apprehension, and the final catastrophe found the people of the vicinity wholly unprepared, and took them by surprise.

Definite information as to the exact nature of the occurrence, and accurate details concerning the phenomena actually appearing, are, from the nature of the case, the remoteness and comparative inaccessibility of the locality, and the character of the rural people chiefly affected, not yet procurable. But the facts as at present demonstrated appear to be as follows: —

About eight o'clock A.M. the residents of the villages around the base and sides of Bantaisan heard loud rumbling sounds, and experienced severe shocks of earthquake. These phenomena were immediately followed by the falling of showers of ashes, which darkened the sky when not illumined by flashes of dazzling flame, apparently emitted from the earth. Violent earthquakes shook the ground, and the crest of Sho-Bantaisan seemed to be lifted bodily upwards, fall again, and totally disappear, in the midst of a violent and deafening explosion.

This phenomenon was followed by showers of red mud, steam, boiling water, and large stones, but no gravel or small stones. Next followed a second shower of ashes mixed with mud, which continued till houses, thatched huts, were buried sometimes to a depth of twenty feet by the ingulfing mass. The phenomena continued in all their severity for about two hours, when the climax seemed to be reached, after which the forces seemed to gradually subside, till about four P.M., when they appeared to have spent their power, and the extent of the catastrophe could be discovered.

All crops for an average radius of five miles from the mountain were destroyed, and great damage was done by the damming of the Okawa River, and consequent inundation of an extensive region. The number of houses totally destroyed was 195, while 63 more were more or less damaged. The total number of deaths is placed at 600, and 476 bodies have been recovered. The number of injured thus far reported is 41, while 1,000 persons are supposed to have been rendered destitute.

Two craters were opened by the eruption, one of which occupies the site of the former upper spring on Sho-Bantaisan, about two miles from the former summit. The diameter of the crater thus formed is little less than five miles, and the mountain-peak above this elevation has wholly disappeared, while one other of the four cones has materially diminished in size. Both craters are at latest accounts, the 26th of July, still in a state of constant though quiet eruption, emitting smoke, steam, and occasionally ashes, the latter having the appearance of disintegrated rock of a dull-bluish color.

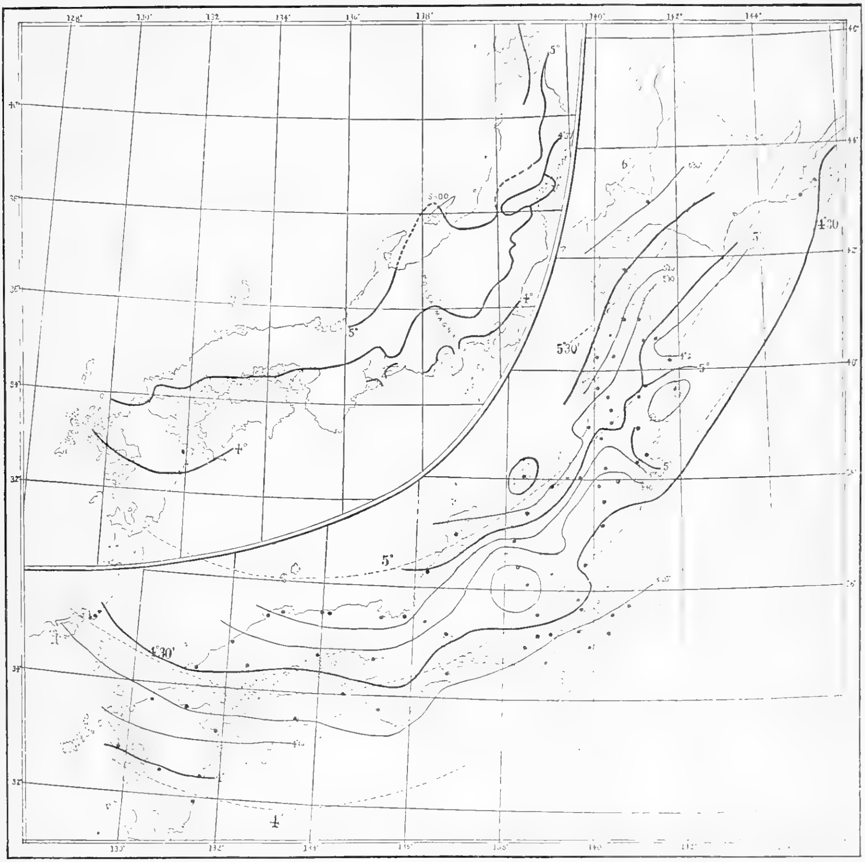
Though an eruption of Bantaisan has never been considered a probable event, and the recent phenomenon has had no local precedent, the mountain is situated on one of the four lines of volcanic activity known to exist in Japan, embracing a series of several active volcanoes; in the light of which fact, the eruption, with all its attending phenomena and ensuing disaster, cannot be regarded as either exceptional or matter for surprise, though possessing unusual scientific interest, and demanding the fullest human sympathy.

H. E. STOCKBRIDGE.

A MAGNETIC SURVEY OF JAPAN.

A RECENT number of the *Journal of the College of Science* of Japan contains the results of a magnetic survey of the islands, carried out by Cargill G. Knott and Aikitsu Tanakadate. The determination of the magnetic elements of Japan is of peculiar interest, as the results of former researches led Dr. Naumann to the conclusion that intimate connections exist between magnetic elements and geological structure. This opinion was based on the magnetic survey of Japan, carried out by Messrs. Sekino and Kodari in 1882–83. A careful review of the methods and results of this survey was therefore very desirable, and Dr. Knott undertook this a fairly good distribution, and a shunning of local disturbances due to volcanic rocks. The second condition was extremely difficult to fulfil, particularly in the northern parts of Japan, where magnetic rocks abound.

Eighty-one stations were occupied in the course of the survey. As the results of the observation on declination are of particular interest in connection with Naumann's theory, we reproduce Knott's map of lines of equal magnetic declination. The lines were drawn by hand from consideration of the observations of contiguous stations. From these he has computed parabolic lines by the method of least squares. We have reproduced these also, although they seem to be of little value, considering the great amount of local



MAP OF JAPAN SHOWING THE LINES OF EQUAL MAGNETIC DECLINATION. (According to Knott and Naumann.)

task. He found that it would be unsafe to deduce from them any definite conclusions as to the general magnetic characteristics of Japan. His principal reason was the inadequate selection of routes, and the fact that the observations were made in two sets, — one in the fall of 1882, the other in the fall of 1883, — the observations being made usually about 9 A.M. or 3 P.M., but not with absolute regularity. He found that no satisfactory attempt had been made to reduce all observations to one hour.

It thus appeared that the thing to be desired was a new survey, — what might be called a preliminary survey of all Japan, special attention to be paid to the distribution of stations. The work was carried out by two parties, one visiting the northern half of the territory to be studied; the other, the southern half. In selecting the stations, two considerations were principally borne in mind, — variation. The lines as constructed by Naumann are shown for comparison on the smaller map.

The following remarks of Dr. Knott are of interest in reference to Naumann's theory. Based on the broad features of Sekino's chart, Naumann finds in the form of the isogonic line of 5° W. a close relation to the so-called 'Fossa Magna.' Just where this great break in the geological continuity of the country occurs, there a large sinuosity seemed to show itself on the isogonic line. This great fault, the Fossa Magna, almost stretches right across the central part of Japan in a nearly north-and-south direction. The well-known volcano Fujiyama is included in it, and so, it is generally supposed, is the line of volcanic islands stretching south-easterly. The Fossa Magna hardly reaches the northen coast of Japan; but, if continued northwards, it would be found to run between the penin-

sula of Noto on the west, and the island of Sado on the east. Now, it is just at this region that Sekino's 5° isogonic line makes a great bend to the north, doubling back just over the island of Sado, and then, after an easterly sweep, continuing north-easterly across the country. It is extremely doubtful whether the observations warrant such a delineation of 5° declination. A careful scrutiny of Sekino's numbers brings out certain discrepancies which should not altogether be neglected. Further, there is a complete lack of observations along the coast to the south and south-west of Sado, — just where observations seem most called for. The stations chosen are all inland, and show striking irregularities in the values of the declinations. True, the declinations at the three stations on Sado are all considerably less than the values at mainland stations immediately to the east, whereas we should expect to find them greater. But that seems hardly a sufficient reason for making the isogone of the form represented; for it is well known that the isogonic lines at and near islands often present irregularities of quite a local description: hence, in default of evidence which could only be obtained by a series of observations along the coast of the main island, it seems more prudent to draw the isogonic line of 5° fairly normal, and represent the disturbance due to Sado by a small isolated contour round that island. In this way it is shown on the map. As a matter of fact, every volcanic region is certain to present magnetic irregularities, and in Japan there are two regions specially to be noted as such. The one is the great central mountainous region, just where the Fossa Magna is. The other is the part between the 38th and 40th parallels, but there is nothing geologically comparable to the Fossa Magna. In both regions a prodigious development of volcanic rocks occurs, and this is presumably the reason for the irregularities in both regions.

Knott does not refer to the great horizontal dislocation which Naumann considers the cause of the northern irregularity. The question at issue is one of great interest. Local variations are observed in every country, even in those where no volcanic rocks occur; and the problem formulated by Naumann, which is a study of the local variations of the magnetic force as connected with the geological structure of the country, is well worth a thorough and continued study.

THE ELECTRIC-LIGHT CONVENTION.

THE National Electric-Light Association met in New York at the Hotel Brunswick on Aug. 29, and continued in session for three days. Pres. S. A. Duncan opened the convention with an interesting address, in which he reviewed the growth of the association and of the electric-light industry. When the association was first organized, the foreign technical papers only noticed its proceedings in order to ridicule them: now the papers read at its meetings are copied by the leading electrical papers all over the world. The membership of the association has largely increased, as has the interest taken in it by the members.

The electric-lighting industry has rapidly advanced in the last six months, since the meeting of the association held in Pittsburgh. Then it was estimated that there were in the United States 4,000 isolated plants and central stations, supplying 175,000 arc lights and 1,750,000 incandescents. To-day there are 5,351 isolated plants and central stations operating 195,000 arc and 1,925,000 incandescent lamps, employing 459,495 horse-power of steam-engines. The increase in the capitalization of the electric-light companies in the last six months has been $42,210,100.

Coming to the question of the distribution of power, there are at present 34 electric railways completed, having 138 miles of track, with 223 motor-cars; there are in course of construction 49 other electric railways, with 189 miles of track and 244 motor-cars; giving a total of 83 roads, with 327 miles of track, operating 467 motor-cars. Besides these, there are 39 other electric roads incorporated which have not yet begun construction.

Mr. Duncan then urged that the association establish a permanent office, which would be the headquarters of the executive committee, and which should contain a good reference-library, together with domestic and foreign electrical journals, and the repository of the archives of the association.

Mayor Hewitt was then introduced, and welcomed the association to New York in a characteristic and eminently common-sense speech. He dwelt particularly on the question of putting electric wires under ground, — a subject in which New York is at present especially interested. To quote one of his remarks, "I congratulate you that it [the feasibility of putting high tension wires under ground] is going to be tested by a responsible company; and until it is tested, let me say to you frankly, that, if it were in my power to compel the other companies to do this thing now, to-day, I would not do it. . . . But I hope it will succeed; and if it does succeed, no public officer will be more prompt than I shall be in compelling every electric-light company to respect the intention of the Legislature." Again, speaking of the danger of the electric currents, Mayor Hewitt summed up as follows: "I found, that, with all the difficulties of this thing, the absolute results seemed to show that it was absolutely safer than any other useful agency at work in this city."

The various papers read before the association were hardly so important as those given at the last meeting at Pittsburgh, but some of them contain valuable information. The following abstracts give the main points in each: —

Mr. S. S. Leonard, in his paper on 'Petroleum Fuel,' said that the advantages of oil over other fuels are many: it is more easily regulated, there is less attendance required, the fires can be started or stopped instantly, there is no refuse to cart away, it is cleaner than any other fuel except natural gas. The arrangements for the use of oil under the supervision of the writer are as follows: the oil is received in tank-cars holding from 90 to 150 barrels each; it is then drawn off into storage-tanks holding 320 barrels. These tanks are boiler-shaped, and are placed under ground end to end, and are connected together. Each tank has a man-hole and vent-pipe. The supply-pipes to the furnaces have valves at the tanks and at the furnace. These pipes are two inches and a half in diameter except about four feet at the furnace end, which is enlarged, and contains a small steam-pipe, which raises the temperature of the oil to 130° or 140°. The experience of the writer is, that the best burner for the oil is one that thoroughly vaporizes it before it is burnt, steam and hot air being used with it. As to economy over coal, there is a saving of from twenty to twenty-five per cent in fuel, and from forty to fifty per cent in labor. From tests recently made, the cost of oil was 70 cents per 100 horse-power per hour; of coal, at the rate of 86 cents per 100 horse-power per hour. Another test gave the cost as 80 cents for coal and 62 cents for oil. As for labor, one man can attend from seven to ten 150-horse-power boilers, while there is no dirt or ashes to haul away.

The discussion on this paper brought out no new facts, excepting, that, in view of the repeated attempts and failures of the past, there was a tendency to mistrust oil as a fuel, both as regards expense and the deterioration of the boilers. It was stated, however, that Mr. Leonard had been using oil for nine months, and was satisfied with its economy and reliability.

Mr. S. S. Wheeler, in his paper on 'Overhead and Underground Wires in New York,' reviewed the history of the Board of Electrical Control, of which he is electrician, and pointed out the difficulties that they had encountered in their work. Besides the fact that there was no precedent to guide them, the wholesale putting under ground of electrical wires never having before been attempted, the local conditions were particularly unfavorable. New York being built on a long, narrow island, the electric wires are crowded together, and the distance between points increased. The ground is full of gas, water, and steam pipes, sewer and pneumatic despatch-tubes, and the earth is saturated with gases. After describing a number of underground systems, Mr. Wheeler gave the history of the modified Dorset conduit used in New York. In the original system the conduit consisted of a bundle of parallel tubular ducts about two inches and a half in diameter, built of blocks made of a mixture of coal-tar, pitch, and gravel, cast with tubular openings running through them from end to end. These blocks were placed end to end so the openings were continuous, and were cemented together. The difficulty in this system was that the blocks were brittle and porous, and they would not remain water-tight. After various modifications, the plan finally adopted was to use parallel

iron tubes, bedded in concrete. There are water-tight man-holes at intervals. The electric wires are drawn into the tubes, and the circuits for the lamps, etc., are taken off at the man-holes. Conduits constructed in this manner seem perfectly water-tight.

There are in New York to-day 420 miles of single duct, containing some 4,000 miles of telephone and telegraph wire, and some hundreds of miles of incandescent electric-light conductors. The conduits for high-potential wires are separated from those for telephone and telegraph wires. Up to the present, no arc-lighting company has put its wires under ground, but the Brush Electric Company is going to draw wires into the conduit between 14th and 34th Streets.

Mr. Wheeler then spoke of the present condition of electric circuits in New York, and pointed out the danger of the great number of 'dead wires,'— wires abandoned by the users, and allowed to remain because of the expense of taking them down. These come in contact with electric-light wires, and are a source of danger.

Summing up, Mr. Wheeler stated that the telegraph and telephone problems were practically solved: 4,000 miles of their wires were already under ground, and 12,000 more were to go this fall. The saving in the cost of maintenance is estimated at $100,000 per year. The laying of electric-light wires is not so fully developed; but when the initiative is once taken, the difficulties will be overcome and the undergrounding will become a settled and accomplished fact.

Dr. P. H. Van Der Weyde's paper on 'The Comparative Danger of Alternating *vs.* Direct Current,' is a criticism on the experiments of Mr. H. P. Brown on the danger of alternating currents, which were described and commented on in the last number of *Science*. It is mainly an attack on Mr. Brown's methods of measurement, and it betrays want of acquaintance with Ohm's law and Cardew's voltmeter. "After the lecture I examined the voltmeter, and found, that, according to the statements of Mr. Brown himself, its operation was based upon indications of rise in temperature. Now, it is well known that voltmeters based on this principle are based on false premises; rise of temperature is not produced by electro-motive force, but by amount of current. . . . This is so self-evident that Prof. G. Forbes from England, who last year exhibited . . . a meter for alternating currents, did not think of calling it a voltmeter, because its operation was based on rise of temperature, but he called it a current-meter." Dr. Van Der Weyde's suggestion for measuring the voltage of the current used possesses the charm of novelty. "In order to come to correct conclusions, it would be necessary to measure, by means of indicator-diagrams, the engine-power utilized, and measure the currents obtained by proper instruments, properly used and conscientiously observed." After this is done, the volts are to be calculated by dividing the energy calculated from the indicator-diagrams by the number of ampères.

The paper, in fact, is of the type that brought the ridicule on the association at its early meetings, of which the president complained in his address.

The other papers read will be given in a later issue.

SCIENTIFIC NEWS IN WASHINGTON.

The Army Medical Museum: a Great Object-Lesson for Those who understand its Purpose and System of Arrangement: Interesting Subsidiary Work. — An International Marine Congress: an Important Plan of the United States Hydrographic Office to be carried into Operation. — Disinfectants that destroy the Germicidal Power of Each Other.

The Army Medical Museum.

OF the thousands of people who visit the Army Medical Museum every year, not one per cent, probably, have any clear conception of the object aimed at in gathering and exhibiting a collection of what to most people are disgusting objects. They look upon the museum as a sort of chamber of horrors, placed there for the purpose of giving people an opportunity to gratify a rather depraved curiosity.

But to those who understand that the museum is a great, systematically arranged object-lesson, in which the physical history of man in health and in disease, and at all stages of development, is given and illustrated, it becomes no longer a place in which to gratify a morbid curiosity, but one in which to pursue, under the most favorable circumstances, one of the most fascinating of studies.

The Army Medical Museum, which for many years was housed in the old Ford's Theatre building, the scene of President Lincoln's assassination, was removed last spring from its contracted and inconvenient quarters to a fine new building erected especially for its use and for the accommodation of the medical library. It is near the Smithsonian Institution and National Museum. A smaller building, to be used as a biological laboratory, has since been added, so detached from the main building and so scientifically and thoroughly ventilated as to make it impossible for gases or odors to pass from it into the main building or into the surrounding air. Congress has not yet made an appropriation to pay for fitting up this laboratory, but is expected to do so in one of the bills now pending.

The museum itself is provided with a large, airy, and well-lighted exhibition-hall in the second story of the new building. There is plenty of room to accommodate it for many years to come, although it is at present receiving accessions at the rapid rate of more than five hundred specimens a year, and is now one of the ten largest medical museums in the world. The aggregate amount of money appropriated by Congress for the museum itself, aside from the cost of the building, has been only about fifty thousand dollars. Several of the great museums of Europe have been in existence since the last century, and the great museum in London began with a collection for which one hundred thousand dollars was paid. In consideration of the short time since the museum in Washington was established, and the small amount of money spent upon it, the results are very highly creditable to Dr. Billings, who has charge of it.

In arranging the objects in the museum, the embryology of man as a complete individual in health is first illustrated. The specimens in this department are numerous and very interesting. The embryology of the lower animals is also shown, as far as it throws light upon that of man, but Dr. Billings does not enter deeply into the illustration of the comparative embryology of the lower animals, as that falls not within his province, but in that of the National Museum.

The next step in illustrating the physical history of man is to divide the body into its several parts, and to treat each separately. For instance, the head is first presented in its healthy state. This is shown in all stages of development, from its first appearance in the embryo, with its gradual growth and the appearance of new organs, to its state of development at the period of birth,— in childhood, youth, maturity, and old age. Not only is the head as a whole shown, but the separate organs are also presented in every form, at all ages, and in all their varying conditions. Here, also, corresponding portions of the lower animals are shown, but, as in the former instance, only so far as they illustrate, and assist in understanding, the organs and functions of that particular organ of the human body. Every part of the body is treated in the same systematic way. There is also a case showing remarkable monstrosities in man and animals.

Having treated and shown the body as a whole in its embryology and its anatomy, and all the parts separately, in its healthy, normal conditions, the next series of cases shows the body in disease. The system of treatment is the same as that adopted in illustrating the body in health. Beginning with the body as a whole, in its earliest embryo state, and showing by actual specimens the effect of all diseases to which it is subject, its different great divisions are shown in all known conditions of disease, from the head, when it first appears in the embryo, through all its history, and in all its separate organs, and in every morbid condition to which its various parts and organs are subject, to the lower extremities. Thus the organ and its several parts are shown through their entire life-history whenever modified by disease. The entire series, therefore, includes a representation, by actual anatomical specimens, of the effect of disease upon every organ of the body. By the side of the diseased organs affected by bacteria that have been identified by biological research, such as typhoid-fever, diphtheria, cholera, yellow-fever etc., it is proposed to place the cul-

tures of the disease-germ of each, actually growing on some sterilized nutrient medium.

The last department of this portion of the museum represents the effect of injury of every known kind upon all portions of the human body. The whole museum presents collectively, therefore, a full history of the human body from its very beginning to its end in old age, under all circumstances of health, disease, and injury.

Special work is also being done in the several separate departments of the museum. One of the most important now in progress is the preparation of a series of sections through the human body, made in every possible direction. The object of these, of which similar ones have never before been prepared, is to show the organs of the human body from every possible point of view, thus, in the complete series, exhibiting, as has never been done before, all the minute relations of adjacent organs. The ordinary anatomical specimen, either of the whole body or of a separate organ, only shows this from one direction. This series of sections is being beautifully mounted, and when completed will be of great practical value to physicians and surgeons.

Another department now being arranged will present, when completed, a full collection of all supplies furnished to an army medical hospital. Not only will all drugs and medicines be shown, but all the instruments used, all the books furnished, and every appliance for the care and comfort of the patient. In fact, there will be nothing ever used in a United States army hospital, from an ambulance to the most common drug, that may not there be seen. These are also arranged, as far as possible, in the manner in which they should be kept in an army hospital; so that, in fact, this exhibit becomes a model for all surgeons in actual charge of hospitals. To supplement the collection above described, there will be added those peculiar articles and appliances supplied in foreign countries to their army hospitals, but not at present to be found in one of our own. A fine collection has already been received from Russia, and there will in due time be added similar collections from all other countries.

One of the assistants in the museum is now engaged in mounting for exhibition the collection of medical medals which Dr. Billings has been several years in making. This includes four hundred specimens, from all countries, of medals specially granted to physicians for distinguished services; as, for instance, in great epidemics, and other circumstances in which great and exceptional services have been demanded. These are being uniformly mounted for exhibition in frames. The collection, already a very fine one, is by no means complete, about two hundred more specimens being needed. Dr. Billings hopes gradually to obtain these. The medals are not only interesting in themselves, many of them being very curious, but scores of them have an immensely added value for the interesting history which they suggest.

An International Marine Conference.

The Pilot Chart for September contains the following: —

"An act of Congress, approved by the President July 9, 1888, provided for an international marine conference to secure greater safety for life and property at sea. Invitations have accordingly been extended to each maritime nation to send one or more delegates, to meet in Washington, April 17, 1889. The purposes of the conference are defined as follows: 'To revise and amend the rules, regulations, and practice concerning vessels at sea, and navigation generally, and the "International Code of Flag and Night Signals;" to adopt a uniform system of marine signals, or other means of plainly indicating the direction in which vessels are moving in fog, mist, falling snow, and thick weather, and at night; to compare and discuss the various systems employed for the saving of life and property from shipwreck, for reporting, marking, and removing dangerous wrecks and obstructions to navigation, for designating vessels, for conveying to mariners and persons interested in shipping, warnings of approaching storms, of dangers to navigation, of changes in lights, buoys, and other day and night marks, and other important information; and to formulate and submit for ratification to the governments of all maritime nations proper international regulations for the prevention of collisions and other avoidable marine disasters.'

"'It will be understood by all States taking part in this conference that no questions relating to trade and commerce are within the scope of the discussion, and that, in the disposition of any questions which may be presented to the conference, no State shall be entitled to more than one vote, whatever may be the number of delegates representing it.'

"The importance of this subject is so great, and the need for concerted international action so pressing, that a full attendance of delegates is confidently expected. This office will gladly do all in its power to facilitate the collection and proper presentation of data, and the officers in charge of the various branch hydrographic offices will receive and foward any well-considered suggestions that may be handed to them. It should be remembered, however, that an intimate knowledge of all the conditions of the problem is very necessary to the suggestion or invention of any scheme likely to possess such merit as to render its adoption at all probable, and every plan should be thoroughly considered in all its details before being submitted. In this way the work of the conference itself will be greatly facilitated."

It is only just to say that this most important conference — important not only to mariners and ship-owners, but to every person who intrusts his life or that of his friends, or his property, to the treacherous sea — was conceived, its purposes defined, and its plan perfected, by the United States Hydrographic Office, which also recommended it to Congress in such a way as to induce that unwilling body to make provision for its expenses. It is certain to be a success.

Disinfectants that neutralize Each Other.

Dr. Joseph Holt, formerly president of the New Orleans Board of Health, in a letter on the yellow-fever in Florida, recently published, used this language: "When the sulphurous fumigation is used after the wetting of surfaces with the mercuric solution, 'the sulphurous gas' does not 'unite with the mercuric salt forming a compound which impairs the germicidal power of both,' as declared by Assistant Surgeon J. J. Kinyoun, of the United States Marine Hospital Service, in his recent report on the Louisiana quarantine. That officer was sent here as an expert, and has made a positive statement in regard to a point in chemistry without having taken the trouble to try the experiment. When sulphurous-acid gas or liquid, or sulphuric acid, is added to a solution of the bichloride of mercury, there is absolutely no chemical interchange, but the solution remains perfectly clear. A drop or two of the solution of the iodide of potash will reveal the mercuric element by an abundant precipitation."

This is a very important matter, on account of its practical bearing on the effectiveness of the two agents mentioned, in disinfection, and the results that follow from using one after the other. Dr. Kinyoun has therefore written a reply, from which the following extracts are taken: "As Dr. Holt is a man who wields a large influence in the Southern country in regard to sanitary matters, I think it only a matter of justice to the public to correct the error that Dr. Holt has himself made in stating that the sulphurous fumes do not form an insoluble compound with the mercuric salt, etc.

"In this connection I would respectfully state that the fact had been long known to me, even prior to my inspection of the Louisiana quarantine, that when SO_2 is passed through, or brought in contact with, a solution of bichloride of mercury, a change took place. The mercuric was changed to a mercurous salt; and, observing it during the process of fumigation, I confirmed it before submitting my report. Owing to the want of time, I have not undertaken to find out the exact proportion of the constituents due to the re-action. Suffice it to say that the precipitate is calomel.

"It is apparent, that, if bichloride solution is used prior to sulphur fumigation, the amount of water alone which is present would absorb a great quantity of the gas, and prevent its penetration where the bichloride solution does not reach; and when the change occurs in the solution of bichloride, it is obvious that the germicidal power of both is impaired. When SO_2 is passed through a solution of bichloride containing an equal quantity of ammonia at the temperature of 25° to 40° C., the change takes place slowly; but when the solution or gas is heated to from 40° to 90° C., the change takes place rapidly, converting nearly all the mercuric to a mercurous salt."

EXPLORATION AND TRAVEL.

The Kongo Free State.

CAPTAIN THYS, on his return from Africa, delivered some very interesting lectures on the state of affairs on the Kongo, which were recently published in the form of a pamphlet. The following notes are taken from this publication. The establishment of easy communication between the upper and lower Kongo is of vital importance for the development of western Central Africa: therefore the Kongo Industrial and Trading Company has taken active measures for the establishment of good roads. A few months ago an expedition was sent out to study the feasibility of a railroad leading to Stanley Pool. After five months of hard work, a hundred miles of the proposed road were surveyed. The whole district to be traversed by the road was mapped on a scale of 1:2,500, with five-metre contour-lines. After this work was completed, the expedition, which is commanded by Captain Cambier, proceeded inland to make a reconnaissance and survey of the upper part of the road. After this preliminary survey has been made, the line will be located and resurveyed. It is expected that this work will be completed this year, and the company expects to make its detailed plans and estimates in the beginning of next year. So far, no serious difficulties have been met with. As the railroad will not be completed for a few years, the company has made an attempt to organize regular caravans for carrying the trade between Matadi and the Pool. At present sixty thousand loads of sixty-five pounds each are transported by carriers through the district of the cataracts. As this method of transportation is expensive and unsafe, it has been proposed to use cattle instead of men. With this aim in view, attempts have been made to raise cattle, and have been found to be successful; and it is hoped that by this means the cost of transportation will be greatly diminished. While the railroad is being surveyed, M. Delcommune has been sent on a commercial reconnaissance of the upper Kongo. In March he started on the steamer 'Roi des Belges' up the Kassai. The pamphlet is accompanied by a sketch-map of the Kongo Free State, by A. T. Wauters, showing the present state of our knowledge of this vast territory. A number of special maps show the situations of the important stations and the route along the Kongo from Matadi to Leopoldville.

THE KASSAI. — The observations of Captain Thys on the Kassai, and its principal tributary the Lulua, have been published by the Institut National de Géographie at Brussels in the form of a large map on a scale of 1:200,000. The map is mainly intended for the use of steamers going up and down the Kassai and Lulua, and the notes on the character of the rivers and their banks have been carefully compiled from the observations of Captain Thys and of Wissmann. While this map is particularly valuable on account of the large amount of detail it contains, Dr. B. Hassenstein's map of the Sankuru, which was published in the July number of *Petermann's Mitteilungen*, must be considered one of the most important contributions to the geography of Africa. In it the surveys of Dr. Ludwig Wolf in 1886, and those of Wissmann and François in 1884–85, have been made use of. The astronomical observations of these travellers have been carefully scrutinized, and the final results obtained by Hassenstein must be considered the most probable, considering the present state of our knowledge. The construction of the upper part of the Lulua is based upon the longitude of Mukenge, near Luluaburg, which has a probable error of $\pm 7'$. The barometer observations have been reduced, and a great number of elevations are contained in the map. The scale of the latter is 1:600,000, and a considerable amount of detail is given. The great value of this publication becomes obvious when comparing it with the preliminary maps compiled from the surveys of these travellers.

BOOK-REVIEWS.

A Guide to the Study of the History and the Constitution of the United States. By WILLIAM W. RUPERT. Boston, Ginn. 12°.

THE first part of this book presents a selection of topics covering the whole period of American history, and accompanied by a numerous list of authorities, the whole being designed as a guide to young students. The author remarks in his preface that "young persons are incapable of distinguishing between important and unimportant historical facts," and therefore need guidance in the study of such facts. This is undoubtedly true; but unfortunately Mr. Rupert is not always successful in making the required distinction himself, for he gives altogether too much attention to military affairs, and too little to some political and social events of far greater importance. In other respects, however, his work is well done. The second part of the book is a brief exposition of the Constitution, giving an explanation of its provisions, and in some cases the reasons why they were enacted. The decisions of the Supreme Court on questions of constitutional law are not given, probably because they were deemed somewhat beyond the province of a schoolbook; but the author's exposition, so far as it goes, seems well adapted to the wants of students in the high schools.

NOTES AND NEWS.

IN the *Overland Monthly* for September is a short paper on orange-culture, by Mr. Adolphe Flamant of Napa; the Grand Cañon of the Colorado is described by Mr. J. G. Lemmon, botanist of the State Board of Forestry; and among the short stories is 'A Question of Will-Power, a Psychological Study,' by A. G. Tassin. —— Ginn & Co. announce 'The Elements of Plane Analytic Geometry,' by John D. Runkle, professor of mathematics, Massachusetts Institute of Technology, as in press. They also invite attention to Taylor's 'Calculus' (differential and integral, in one volume), lately adopted by the Massachusetts Institute of Technology. —— 'The Relation of the Sexes to Government' will be discussed by Prof E. D. Cope in the October *Popular Science Monthly*. The differences between the two French schools of hypnotism will be set forth by Dr. Christian A. Herter, under the title 'Hypnotism: What it is, and What it is not.' Under the title 'Ethics and Economics,' Mr. Robert Mathews will give a thoughtful view of our social outlook. —— Henry Carey Baird & Co. will publish on Sept. 15 a new book on steam-engineering, entitled 'The American Steam-Engineer, Theoretical and Practical,' by Emory Edwards, the well-known author of 'The Practical Engineer's Guide,' etc. The author in the forthcoming book will give examples of the latest and most approved American practice in the design and construction of steam engines and boilers of every description. —— The J. B. Lippincott Company will publish on Sept. 14 the second volume of the new edition of Chambers's Encyclopædia, from Bea to Cat. The same thorough revision and accuracy that characterize the first volume are also found in the second. It contains 828 pages, is profusely illustrated with new woodcuts, and supplied with maps of Belgium, Burma, California, Dominion of Canada, Eastern Provinces of Canada, Cape Colony, and South Africa. They will begin at once the publication of a series of biographical studies of the great men who have influenced the social and political history of the world, under the general title of 'International Statesmen Series.' It is to be edited by Mr. L. C. Sanders, and its scope will be comprehensive, embracing the ancients and the moderns, and including not only the creators of the English Commonwealth, but also the makers of European and American politics, and the founders of the Indian and Colonial Empires. The initial volume of the series is 'Lord Beaconsfield,' by T. E. Kebbel, author of a 'History of Toryism.' —— Messrs. Trübner & Co., London, announce 'The Literature of Egypt and the Soudan,' by H. H. Prince Ibrahim-Hilmy; 'Mediæval Researches from Eastern Asiatic Sources,' by E. Bretschneider, M.D.; 'Table of Quarter-Squares of all Numbers from 1 to 200,000,' calculated by Joseph Blater; 'Bibliography of South Australia,' compiled by Thomas Gill; and 'Manual of New Zealand History,' by J. Howard Wallace.

— During the total eclipse of the moon on Jan. 28, 1888, Prof. W. H. Pickering searched, by means of photography, for a lunar satellite. The results of his observations have been published in the 'Annals of Harvard College Observatory.' The method of observation was to direct the telescope, with the camera attached to it, towards the moon, and to adjust it so as to follow the motion of the latter. The effect is, that the stars are represented as short lines, while any satellite, whose motion would probably be in accordance with that of the moon, would appear as a point or a line

having a direction different from that of the stars. The search was unsuccessful; and Pickering concludes from the results that the satellite, if existing at all, has a diameter of less than two hundred metres.

— Rudolf Clausius, the eminent physicist, died on Aug. 25 at Bonn. Clausius was born on Jan. 2, 1822, at Koeslin. In 1840 he commenced his studies at the University of Berlin. After having taken his degree, he became lecturer of physics at this university, holding at the same time the position of teacher at a military academy. In 1855 he was appointed professor of physics at Zürich, and in 1867 he was elected by the faculty of Würzburg, at which university he remained for two years. Since 1869 he has been professor of physics at the University of Bonn. His work on the theory of heat is so well known that we do not need to sum up his merits. His important researches on this subject were first published in *Poggendorff's Annalen*, and later on collected in a work of two volumes, the first of which treats of the theory of heat, while the second refers to the applications of the theory to electricity. With admirable modesty he termed his most important discovery 'the principle of Carnot,' as in following his line of research he was led to its discovery.

LETTERS TO THE EDITOR.

Mississagua Etymology.

A RECENT visit to the Mississaguas of Scugog Island (a remnant of a once powerful branch of the great Ojibwa confederacy) has enabled me to collect some interesting philological and folk-loristic information. Their language is nearly pure Ojibwa, and was in its uncorrupted form a purer dialect than that of Baraga's Dictionary. This conclusion is based upon a vocabulary of some five hundred words collected during my visit, and upon a manuscript French-Indian vocabulary of the region between York (Toronto) and Lake Simcoe of a date *circa* 1803. The words dealt with here were explained to me carefully by Mrs. Bolin, an aged member of the Scugog tribe, a very intelligent woman. Her Indian name is Nawigishcoké ('the sun in the centre of the sky'). She is about sixty-five years old.

Manitoominis ('bead') literally means 'mystery-seed.' The Indian was very much puzzled when he saw beads for the first time. *Musawkwodon* ('beard') literally means 'fuzzy-mouth.' *Musons* ('caterpillar'), the same word as that for 'nettle,' means 'fuzzy thing.' *Muskegamin* ('cranberry') means 'swamp-fruit.' *Shaganosh* ('Englishman') was explained as meaning 'sailing round the world.' The brother of the Mississagua chief at Scugog is called Shawanosh ('sailing from the south'). It is the termination of these words that gives the idea of sailing. *Wamitigoshi* ('Frenchman'), Mrs. Bolin explained to me as meaning 'he who carries a trunk.' She said that no doubt the first Frenchman with whom the Indians got acquainted carried, for some purpose or other, a trunk or box, hence the name. *Shabomin* ('gooseberry') is 'the transparent fruit.' *Pajicogoshi* ('horse') is 'the animal with one hoof.' *Piwabik* ('iron') is 'the metal that crumbles off.' *Oshkikwomin* ('lead') is 'that which can be cut with a knife.' *Wabimojichagwan* ('looking-glass') is a most interesting word. Mrs. Bolin explained it as meaning 'where ghosts are seen.' When the Indians first became acquainted with looking-glasses, they imagined that in them they saw their ghosts or spirits (*ojichag*). *Ashebojanak* ('oar') is from *ashebojan* ('to row'), the literal meaning of which is 'to sit backwards,' referring to the position assumed when rowing as opposed to paddling. *Pajicogoshinijin* ('oats') are literally 'horse's food.' *Ocadak* ('sarsaparilla') is 'the leg-root.' *Menagwacomis* ('sassafras') is 'the scented tree.' *Manitanis* ('sheep') is 'the animal that has the damaged hide,' or the hide that is not durable, as that of deer, etc. *Papakawaiyon* ('shirt') means literally 'thin wear.' *Shishibanwing* ('shot') is literally 'duck-stones.' *Muskeg* ('swamp') is a 'place which is full of sticks.' *Nibanakwanisitan* ('toes') are so named from their running in rotation. *Pakweshikanusk* ('wheat') literally means 'bread-herb.' *Wasaijakon* ('window') is 'that by which the light (*wasaija*) comes in.'

A few other examples might also be given. *Miskotchies* ('beet') literally means 'red turnip.' *Osawascopineshi* ('bluebird') means the same as in English. *Osawatchies* ('carrot') is 'the yellow turnip.' *Eshkon* ('chisel') means literally 'horn,' showing of what material these implements were made in the past. *Papiga omukaki* ('toad') is literally 'the rough frog.' *Papassa* ('woodpecker') means literally 'the pecker.'

At Scugog, English is fast superseding the native Indian language, and soon one of the most interesting and most constructive of American aboriginal tongues will have ceased to exist upon the island. A. F. CHAMBERLAIN.

Toronto, Aug. 15.

The Limit of Drift.

MAPS showing the drift-limit fix the boundary in Kansas a few miles south of Lawrence and Topeka. These are possibly correct so far as the drift-sheet is concerned, but erratic bowlders have strayed from their native ledges about Lake Superior to a greater distance. One of granite, weighing over 360 pounds, was found by the writer near the summit of a divide thirteen miles east-north-east of Eureka, and seventy-five miles south of Topeka, Kan. The elevation is about 1,160 feet above the ocean. It lay nearly buried in the soil near the head of a draw tributary to West Creek, a tributary of the Verdigris River. The draw trended south-south-west; and the configuration of the country immediately northward, on the opposite side of West Creek, lends weight to the supposition that that was the direction the emigrant travelled when he entered southern Kansas.

No other bowlders have been found in the neighborhood. This one has five planed faces, and bears other marks of having travelled, part of the way at least, at the bottom of a glacier. The country immediately north has never been visited by the writer, and so it is possible that other drift-material lies in that quarter, but none exists here.

If the attenuated margin of the glacier stopped some miles to the northward, and this country was flooded with water, it seems strange that so few bowlders floated away in bergs or floes. If this country was flooded to a sufficient depth to float bergs with bowlders, the eastern margin of this State must have been occupied by a river of extraordinary dimensions, emptying southward, etc. The find is very suggestive of questions. L. C. WOOSTER.

Eureka, Kan., Sept. 5.

A Brilliant Meteor.

ON Sunday evening last a meteor was seen by several people in and around this city, but, so far as I can learn, Mr. J. C. Mayo was the only one who made reliable time-observations of its appearance and disappearance.

Mr. Mayo is the telegraph-operator and stenographer of the Blue Bird Mining Company, Limited, and resides at the Blue Bird Mine, about three miles west of Butte City.

At 6.30 P.M. by Mr. Mayo's watch, which was five minutes slow of local time, a meteor burst into view in the southern heavens, and moved in an apparent downward and north-easterly direction. About two seconds (estimated) after its appearance the meteor burst, first into two parts, and then into fragments which immediately disappeared. Mr. Mayo, having his watch in hand, noted the time at which the meteor burst, and then listened for a report. At the expiration of five minutes and thirty seconds two loud reports, nearly simultaneous, were heard. These reports were like the explosions of heavy blasts of powder, and were followed by a rumbling like near thunder, lasting about ten seconds.

The place in the sky where the meteor was first seen, as pointed out to me, was S. 60° E. from the Blue Bird Mine, at an elevation of 50° from the horizon. The place where it burst was due east and at an elevation of 25°.

Mr. Mayo describes the meteor as having a well-defined body, egg-shaped, with the smaller end foremost. This body was distinctly visible, "resembling white-hot iron," giving off a pure white light, and was followed by a "bright blaze," which shaded into a dense white, "sulphurous" smoke. The trail of smoke left behind remained visible for fully ten minutes.

The sky was clear and the sun shining brightly; but the meteor apparently emitted as much light as the sun, and lighted up its shadows. A. B. KNIGHT.

Butte City, Montana, Aug. 22.

Publications received at Editor's Office, Aug. 27–Sept. 8.

ERDE, Die. Lief. 31–35. Leipzig, Hartleben. f°.
GREENE, F. B. First Lessons in English. Philadelphia, Cowperthwait & Co. 144 p. 16°.
HINMAN, R. Eclectic Physical Geography. Cincinnati and New York, Van Antwerp, Bragg, & Co. 382 p. 12°. $1.
RUPERT, W. W. A Guide to the Study of the History and the Constitution of the United States. Boston, Ginn. 130 p. 12°. 75 cents.
SIMON, W. Manual of Chemistry. 2d ed. Philadelphia, Lea Bros. & Co. 479 p. 8°.
UNIVERSITY Studies. Vol. I. No. 1 July, 1888. Lincoln, Neb., Univ. of Neb. 66 p. 8°. $3 per year; single numbers, $1.

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Microscope, The	1.00	4.25	2.25
Nature	6.00	8.80	7.00
New Princeton Review	3.00	5.80	4.00
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Political Science Quarterly	3.00	5.80	4.00
Popular Science Monthly	5.00	7.80	6.00
Popular Science News	1.00	4.25	2.25
Portfolio, The	7.50	10.30	8.50
Practitioner	3.50	6.30	4.50
Public Opinion	3.00	5.80	4.00
Puck	5.00	7.80	6.00
Puck (German)	5.00	7.80	6.00
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Queries	1.00	4.25	2.25
Rural New-Yorker	2.00	4.80	3.00
St. Nicholas	3.00	5.80	4.00
School Journal	2.50	5.30	3.50
Scientific American	3.00	5.80	4.00
Supplement	5.00	7.80	6.00
Architect and Builders' edition	2.50	5.30	3.50
Scribner's Magazine	3.00	5.80	4.00
Southern Cultivator	1.50	4.30	2.50
Springfield Republican (weekly)	1.00	4.25	2.25
Sunday School Times	2.00	4.80	3.00
Teachers' Institute	1.25	4.05	2.25
Texas Siftings	4.00	6.80	5.00
Treasure-Trove	1.00	4.25	2.25
Truth Seeker, The	3.00	5.80	4.00
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Young Folks' Journal	1.00	4.25	2.25

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SCIENCE

FRIDAY, SEPTEMBER 21, 1888.

THE WANT which has been long felt in cities for properly trained nurses has been fully met by the training-schools, which have sprung up in almost every city, and in connection with almost every hospital. But in the smaller towns and villages the need is as great as ever, and, so far as we know, no effort has been made to meet it. It has been claimed that the supply has not been furnished because there was no demand for such services. This may be true to some extent, but does not account for the almost total lack of properly educated nurses in the country. The explanation is, we think, rather that, the system being a comparatively modern one, it was but natural that it should at first be put into operation in the large centres of population; and, as these are now fairly well supplied, it will doubtless follow that when the supply exceeds the demand, as it bids fair soon to do, the trained nurse will naturally seek employment in the smaller towns and villages. In the mean time residents of these villages who desire to introduce such a system into the places of their residence will find the fullest instructions in a book recently written by Dr. Worcester of Waltham, entitled 'A New Way of training Nurses.'

THE STANLEY EXPEDITION.

IT may be well to review at the present time the progress of the Stanley expedition and the events on the upper Kongo, in order to understand the real value of the numerous rumors that have been reported as to the fate of the explorer and of his caravan. On March 18, 1887, Stanley arrived at Banana, and with some difficulty reached Leopoldville on Stanley Pool on April 20. On June 2 he left his camp at the mouth of the Aruvimi, ascending the latter river. At that time it was hoped by well-informed persons that he might be able to reach Wadelai towards the end of July, although a delay of many months did not seem at all improbable. On Aug. 4 it was announced that on the 18th of June, Stanley had reached the rapids of the Aruvimi, and that he was preparing to make a portage. On June 23 Stanley sent a letter from Yambuya on the Aruvimi, and on July 12 a despatch was sent that all was well. He was proceeding up the Aruvimi with a caravan of fifty Europeans and four hundred and sixty-five soldiers and carriers.

Near the mouth of the Aruvimi, Major Barttelot was left in command of a fortified camp with four European and one hundred and twenty-five Zanzibar soldiers, and ample provisions, with the instruction to follow on Stanley's route as soon as Tippo-Tip should have gathered a sufficient number of carriers. It will be remembered that at that time the Arabs were in possession of Stanley Falls Station, and that, by appointing Tippo-Tip chief, the Kongo Free State hoped to again get control of that place. On May 31 Stanley and Tippo-Tip separated, after having passed Bangala. The latter, accompanied by ninety-six persons, and Major Barttelot, who was in command of forty Sudanese soldiers, proceeded up the Kongo. On June 22 Barttelot reached Yambuya, where he met Stanley. Tippo-Tip, on his arrival at Stanley Falls, and on announcing his appointment as chief of the Falls Station, met with some resistance among the Arabs, particularly from one Said-ben-Habub, who refused to obey him. Tippo-Tip then demanded from the Kongo State two officers and thirty soldiers for enforcing his commands. When this news reached Europe, Captain Liévin Van de Velde was appointed commander of the garrison of Stanley Falls, and left Antwerp on Oct. 23. Unfortunately he died a few days after his arrival on the Kongo. For a long time no news from Barttelot reached the coast, until a despatch from St. Paul de Loanda, dated May 1, announced that Mr. Ward had arrived from Yambuya at Boma, with the news that nothing had been heard from Stanley since July, 1887. Tippo-Tip had left for Kasongo, situated above the Falls, on Nov. 16, but in March he had procured only two hundred and fifty carriers. Jamieson had gone to the same place to urge the despatch of three hundred and fifty carriers more who were wanted. He was expected back at Yambuya on May 14, and Barttelot did not expect to leave until June 1. It was his intention to proceed *via* Stanley Falls, where he intended to leave an officer in charge of every thing he could spare. Later on, Jamieson reported their intention to start. The last news from this region was that the Falls Station was re-occupied by the Kongo Free State, under command of Captain van Gèle.

The numerous reports of Stanley's death or of his progress that were published at brief intervals were without any foundation. The only rumors from the west coast that had any elements of truth were contained in Barttelot's last letter, which was received in Brussels on the 15th of June. In December, 1887, several deserters from Stanley's expedition were met with several days' journey up the Aruvimi by Arabs. They told that they had left Stanley after five months' hard travelling in a mountainous region, covered with dense forest and very populous, the expedition having to fight frequently against the natives. In one of these struggles Stanley was said to be wounded. The situation at Yambuya was very difficult on account of scarcity of food. Tippo-Tip, although not unwilling to keep his promise of sending carriers, found it extremely difficult to induce the natives to take part in an expedition toward the unknown northern regions.

It is well known that deserters always describe the state of the caravans as hopeless, in order to exculpate themselves, and therefore their tale must be accepted *cum grano salis*. This report was repeated, somewhat amplified and exaggerated, by a despatch of Reuter's Bureau.

We turn to considering the news coming from East Africa. A despatch of May 28 shows how slowly trustworthy information travels this way. This telegram, which was published in the London *Times*, stated that letters were received from Barttelot, dated Stanley Falls, Oct. 25, which referred to some deserters having come down to that station.

While this meagre news is all we know about Stanley, letters from Emin Pacha come in comparatively regularly, showing that an open route exists from his province to Zanzibar. The last letter from the region occupied by Emin Pacha was written on Dec. 5, 1887, by Casati, at Guaia in Unyoro. He says, "I do not believe that Stanley will arrive very soon. No news, however vague, has come here from the West. I am convinced that he cannot be here before March. The size of his caravan, and consequent difficulty of obtaining provisions, sickness, etc., — these are serious obstacles to his rapid progress."

Another report from this region was obtained at Cairo, July 5. A messenger who had left Khartum May 25 says that he has noticed the preparations made by the Mahdi since the middle of March for an expedition against Emin. The expedition consisted of four thousand men, who took passage in four old steamboats of Gordon.

The last exciting reports from this region are the Reuter despatches referring to the white pacha who was said to be encountered by Arabs in the Bahr-el-Gazal region. It is hardly possible to tell what may be the foundation of these repeated reports.

From all these facts we conclude that there is no foundation to the numerous reports of Stanley's death. The difficulties he must have encountered on his march must have been unexpected, or he may have had in view an object entirely different from the alleged 'relief' of Emin Pacha. So far, we are not justified in supposing that he has perished, else some news to this effect would have reached the Kongo.

A few days ago a despatch was sent from the Kongo reporting

the death of Barttelot, who was murdered by his carriers. It has not been stated how this news reached the coast, but, since the re-establishment of intercourse with Stanley Falls, its authenticity seems not improbable. The cable (London, Sept. 14) reports, "A despatch from St. Paul de Loanda states that Major Barttelot was shot on July 19 by his Manyema carriers. The head Arab and his men thereupon ran off to Stanley Falls, where Jamieson is making arrangements with Tippo-Tip for the organization of an expedition. He will proceed as quickly as possible. The London newspapers are unanimously of the opinion that Major Barttelot was betrayed by Tippo-Tip, who organized the native portion of the expedition; and the question is asked, Why may not Stanley have been also the victim of his treachery? Nyangwe, the home of Tippo-Tip, is three hundred miles distant from Stanley Falls. The first despatch said that Tippo-Tip was at Nyangwe. The second does not indicate whether he is still there, or has returned to Stanley Falls. Colonel De Winton is of the opinion that Barttelot was murdered between the twenty-eighth and twenty-ninth degrees of east longitude at about the second degree of north latitude. The Manyema twice attempted to take Livingstone's life. The second despatch removes from the Arabs the suspicion of treachery."

All the evidence tends to show that there is no intention on the part of Tippo-Tip to betray Stanley. Furthermore, it must be borne in mind that Barttelot at an early date had an encounter with natives of the same tribe, in which several of Tippo-Tip's men were killed. It seems that he was almost too energetic in his dealings with the natives.

A despatch dated London, Sept. 16, says, "Captain Vangele, who has just returned to Europe from the Kongo country, says he is convinced of Tippo-Tip's innocence of the murder of Major Barttelot. Tippo-Tip, he says, is engaged entirely in commerce, and had an interest in the success of Major Barttelot's expedition. The porters who accompanied the expedition were furnished by Tippo-Tip. They agreed that they should be paid on reaching Zanzibar, and to this fact Captain Vangele partly attributes the murder, because the payment of the porters depended upon the success of the journey. He thinks the strict discipline preserved by Barttelot may also have aroused hostility. He believes that Jamieson will find it difficult to organize a new expedition. Captain Vangele is convinced that Stanley is safe."

It is not quite clear to us whether 'Vangele' is the same Van Gèle who left Leopoldville on April 26 to occupy Stanley Falls. His return to Europe at this time seems hardly probable, although we do not know what has been going on on the upper Kongo during the last months.

Meanwhile committees are forming in various countries for the relief of Emin, or rather for supplying Emin with ammunition and opening a route to his province. Foremost in these endeavors is at present the German East African Association, but so far no definite results have been obtained.

MEDICAL MUSEUMS.

THE Congress of American Physicians and Surgeons closed its meeting in Washington last evening with an address in the National Museum from the president, Dr. John S. Billings, and a reception in the Army Medical Museum. Dr. Billings's audience was a large and appreciative one; and he made his address on medical museums, with special reference to the Army Medical Museum at Washington, exceedingly interesting as well as instructive and suggestive.

The necessity of economizing space prevents the reproduction here of the very interesting historical enumeration of the leading medical museums of the world, with which Dr. Billings opened his address, and we pass at once to the central topic, condensing as the exigencies of space demand. He said: —

"This collection, known as the Army Medical Museum, owes its inception to Dr. William A. Hammond, one of whose first acts after becoming surgeon-general, in 1862, was to issue a circular stating, that, 'as it is proposed to establish in Washington an army medical museum, medical officers are directed diligently to collect, and to forward to the office of the surgeon-general, all specimens of morbid anatomy, surgical or medical, which may be regarded as valuable, together with projectiles and foreign bodies removed, and such other matters as may prove of interest in the study of military medicine or surgery.' By the end of the year, over a thousand specimens had been collected, and the catalogue printed in 1866 showed that it contained 7,716 specimens. It is not my purpose in this address to trace the history of its development: that must be done elsewhere. It has recently been placed, with the library, in a conveniently arranged fire-proof building, and on the 1st of July last contained over 15,000 specimens besides those contained in its microscopical department, divided as follows: —

Comparative anatomy	1,689
Pathological	8,354
Medals	384
Microscopical specimens	10,416
Normal human anatomy	2,961
Instruments and apparatus	814
Microscopes	141
Miscellaneous	835

"Besides these, there are 375 specimens pertaining to normal human anatomy, and 726 to pathological anatomy, which are in what is called the 'provisional series.'

"At first the Army Medical Museum was limited to military medical subjects; but of late years its scope has been greatly broadened, and is now nearly the same as that of the Royal College of Surgeons. It includes human anatomy, physiology, pathology, somatological anthropology, instruments and apparatus, and illustrations of methods of teaching connected with special departments of practical medicine. It does not at present include hygiene or materia medica, except in their immediate relations to the military medical service; and this for reasons which will be stated presently. That our National Medical Museum should be broad and comprehensive in its scope, there can be no doubt, its requirements in this respect being quite different from those of collections formed and used more especially for the purpose of teaching medical students. The most practically valuable of these last are those formed by individual professors to suit their own specialties and methods of teaching. They need not, as a rule, be large. I may even say that they should not be large; for the labor of properly preserving a large collection is great, and the student, with his limited time and want of knowledge of what to look for, can examine but few specimens so as to profit by them. For the same reason specimens of rare abnormities, of double monstrosities, etc., are of little use in ordinary medical teaching as given in this country, and are not specially desirable in the museums of our medical schools.

"You may have noticed, that, in speaking of the scope of our museum, I said it included 'human anatomy.' This phrase does not mean that it has no specimens illustrating the structure of other animals, for it has many, and needs many more; but it means that in this department its main purpose is not to make comparative anatomy an end to itself by exhibiting all known variations in structure throughout the animal kingdom as a basis for their study in relation to development and environment, causation and results: in other words, it is not an anatomical museum, but a medical museum. The broad field of general biology, including natural history and comparative anatomy, will ultimately be covered by the National Museum; and in our medical collection it will be quite enough to illustrate human anatomy fully, using so much of the structure of the lower animals as will be useful in explaining why certain parts of the human body are thus and so, and not otherwise. No sharp line of distinction can be drawn between the field of work of the general and that of the medical museum. So far as morphology is concerned, they must necessarily overlap somewhat, since both want a certain number of the same specimens, although using them to illustrate different points of view.

"The kind of specimens most valued for illustrating anatomy in a museum is now very different from what was sought for in the first half of this century. Dried and varnished dissections showing blood-vessels, etc., are now looked on as nearly useless, and are kept only as historical relics. Elaborate dissections under alcohol, mounted in opaque dishes with flat glass covers, and sections of frozen bodies similarly mounted, are what the student and the practitioner most desire to see. In our museum there are some ex-

cellent specimens of this kind, prepared under the direction of Professor His of Leipzig, of Professor Cunningham of Dublin, and by our own anatomist Dr. Wortman. These, however, are only samples to show how the work should be done. We require several hundred such specimens to illustrate properly regional anatomy in relation to age and sex, while the possible applications of the same methods to the illustration of visceral displacements, hernias, and deformities of all kinds, are boundless. As regards physiology, but little can be done by museum specimens to illustrate function as distinguished from form and structure. The so-called 'physiological series' in the Hunterian collection is a series of organs illustrating variations in different families of the animal kingdom, or at different ages: in other words, it illustrates ontogenic and phylogenic development. The things students or teachers of physiology are most anxious to see in a museum are specimens of instruments and apparatus employed in experimental physiology, or in the measurement of the special work of different organs, or in illustrating lectures on physiology. Illustrations of results obtained in experimental pathology often belong quite as much to physiology; as, for example, specimens of results of Gudden's atrophy method.

"The Army Medical Museum has only a beginning of such an anatomical collection as I have indicated as desirable. Like all other museums, it is richer in specimens illustrating osteology than in any other branch of anatomy, simply because such specimens are the easiest to obtain and preserve. We are accustomed to think that human anatomy is nearly exhausted as a field for original research, and that, at all events, every important organ or muscle or nerve has been figured, described, and named. Granting this, so far as the adult is concerned, although it is by no means true even for him, we have still to study the development of each of these organs, or groups of organs, as seen at different ages, and, for some of them, in different races. As fast as these points are seen to be of practical interest, either in connection with diagnosis or the surgical treatment of disease, they are investigated; but an ideal museum should furnish the investigator the means for his researches, and it must therefore collect specimens without special regard to what is at present known to be their practical interest. The collection of such series of specimens of each joint, region, and organ, as I have in mind, including sections and dissections at different ages, from the earliest appearance in fœtal life to extreme old age in man, and in many cases in the lower animals, is a slow process. Such specimens, and especially such series of specimens, can only be prepared by a skilled anatomist, and there are few such: hence the formation of our ideal anatomical collection, limited though its scope may be, must be a work of time.

"Having obtained the specimens, the next difficulty is so to prepare and preserve them that they shall be available for study. The great majority cannot be preserved in such a manner as to retain their natural color, size, and texture. No doubt, more might be done in this direction than is usually done. It is possible to stain or paint portions of specimens in such a way as to give some idea of the normal appearances; but thus far, I think, experience shows that the best medium for the permanent preservation of wet pathological specimens is alcohol, and this will contract and harden most tissues, and remove the color from nearly all. It is also an expensive mode of preservation for large collections, and requires constant care to prevent the effects of evaporation. It does not follow, however, that such specimens are of little value, and that, as some have urged, it would be better to seek to obtain records of the results of disease by colored drawings or models. The pathological specimen, whether seen at the post-mortem, or years afterward in a museum, is, to the scientific pathologist or the practical physician, merely a sign or hieroglyph of the morbid process which has produced it: it is a result, in most cases, of interest not in itself, but because of the preceding phenomena which it connotes. As Sir James Paget has said, the same objection, viz., that museum specimens are unfit for the teaching or the study of pathology, might be made to the study of botanical specimens in an herbarium. 'In both cases alike, the changes produced by preparation are so far uniform that any one accustomed to recent specimens (and no others should study either herbaria or pathological collections) can allow for them or "discount" them. Just as an anatomist can discern, in a recent specimen of disease, the healthy structure, so, but often much more clearly, can the pathologist or any careful student discern in the prepared specimen the chief characteristics of the disease.' Colored drawings, casts, and models are of great value in supplementing original specimens, but they cannot wholly replace them.

"One of the most important sections of our museum is that devoted to microscopy, including normal and pathological histology and photomicrographic work. In the cabinets there are nearly 11,000 mounted specimens, illustrating almost every field of microscopical research. Many of these were made twenty years ago, and more, and were mounted by processes which have not given good results; so that Dr. Gray, who is in charge of this section, estimates that about 3,000 will be set aside as worthless; but the rest form a very valuable series, to which additions are being constantly made, and materials for which we are specially anxious to obtain. In connection with this section, a series of cultures of chromogenic and pathogenic bacteria is kept up for museum exhibits, and also to illustrate methods of work.

"While the great majority of the specimens in a medical museum have some relation to diagnosis, prognosis, or therapeutics, the number of those which are of direct interest to the so-called practical physician is not very great. It includes models and casts illustrating dermatology, morbid growths, the results of amputations, excisions, plastic operations, etc., and instruments, apparatus, dressings, etc., of all kinds. Here also may be classed hospital fittings and furniture, means of transportation for sick and wounded, model cases of instruments, emergency chests, etc. Our medical museum has a fair beginning of a collection of this kind, including over a thousand specimens; but many more are needed to make it reasonably complete. If each medical man who devises a stethoscope, a pessary, a speculum, an ophthalmoscope, or an electro-therapeutic appliance with which he is well pleased, would send a specimen to the collection, its increase would certainly be rapid, and it could always show the latest improvement.

"The Army Medical Museum contains what may seem a large amount of material relating to human osteology, and especially craniology, in its relations to North American ethnology, or the history of the development of different varieties of man on this continent; but it is not actually half large enough to permit of drawing definite scientific conclusions from it. The majority of the crania which it contains have been measured to a certain extent, and the results have been published; but many other measurements are desirable to permit of comparison with series taken elsewhere, and even measurements already made must be repeated by later and better methods. We have been trying some experiments with composite photography and superimposed contour tracings as a means of obtaining typical outlines and dimensions for race groups of crania, and these give promise of good results. If the collections of crania of North American Indians in Boston, New York, Philadelphia, and Washington could be brought together, a very much better average representation of the majority of tribes or groups would be obtained than can be furnished by either of these collections taken separately. By composite photography and tracings, combined with uniform methods of measurement, we can practically bring these collections together, and obtain results nearly as satisfactory as if we had them all in one room. We have also fitted up one large room with instruments and apparatus for anthropometry in its widest sense, including psychophysical investigation; and it is intended to make this a complete laboratory for illustration of methods of work.

"An important feature of our National Medical Museum should be to show methods of research and of instruction for the benefit of the investigators and teachers of the country. This includes instruments and apparatus, and, to a limited extent, illustrations of the modes of using them and of the results; it also includes diagrams, models, etc., used for illustrating lectures. For example: as soon as Koch's researches became known in this country, physicians, and especially medical teachers who visited the museum, asked if we could show them the apparatus used by Koch and Pasteur in bacteriological work, and eagerly examined the few specimens of cultures on solid media which we were able to exhibit. The anatomist comes to the museum quite as much to see methods of mounting and preservation as to see the specimens

themselves; the physiologist does not expect to see function directly exhibited, but he does hope to find information about kymographs and constant-temperature apparatus, and he wants to see whether Kühne's artificial eye is so useful for teaching purposes that he ought to get one to illustrate his lectures.

"Medical museums are not, as a rule, freely open to the public, nor are they collected or arranged with reference to interesting or instructing non-professional persons. The Medical Museum at Washington is the chief exception to this rule; and it is so, because it was placed in Ford's Theatre, the scene of the assassination of President Lincoln. Many visitors to Washington, both men and women, wished to see this memorable spot, and, in doing so, necessarily went through the museum. This gradually led to the adjusting of the specimens exhibited with a view to the fact that they were to be seen by a number of non-professional persons of both sexes. Certain groups of specimens were put aside and not shown, except to persons known to be physicians, while other groups were given prominent places because they interested the public, although not of great professional or scientific value.

"I have time for only a very condensed statement of the wants of our National Medical Museum. In the first place, it needs the intelligent interest and friendship of the medical profession of this country. To a very considerable extent it has had this. Were it otherwise, it would not be what it is, nor where it is. But it needs more of it, and it can never have too much. Every medical man in this country should help a little, and provide for the perpetuation of his name as that of a physician interested in the progress of the profession, by sending at least one specimen to it. It is omnivorous in its demands for material, as will be seen by the circular which it has recently issued. But I will name as special wants, human embryos, especially those of a very early age; monstrosities and malformations of all kinds in man or in the lower animals; results of old injuries, such as fractures or dislocations, or of surgical operations, such as excisions, stumps, etc.; injuries and diseases of the eye, ear, and nose; new growths of all kinds; diseases of the brain and spinal cord; and specimens illustrating the condition of bones, joints, brain, larynx, and other organs, in extreme old age.

"In the second place, it needs a regular supply of funds from the general government. To form and keep in proper condition such a medical museum as this should be, is a more difficult and expensive matter than those not acquainted with such work would suppose; and the gifts of specimens from the profession must be supplemented by ample means for the preparation, preservation, and proper display of these specimens, and also for the purchase of apparatus and typical specimens of foreign work, in order that the museum may be always able to show the latest state of knowledge and the best ways of doing things.

"The annual appropriation for the museum at present is $5,000. This is sufficient, except that the printing of the catalogue, of which I shall speak presently, must be an extra charge; but the medical profession should see to it that the amount is not reduced in the rhythmic spasms of partial economy with which some of our statesmen are afflicted.

"The third need of the museum is a series of the right kind of descriptions of its specimens, given on labels and in a catalogue. Unaided by such descriptions, it has for each man that which he can see in it, and no more. One man will see nothing but an old piece of bone, a shapeless mass of tissue bleached by alcohol, a case of old dingy brass instruments. Another will see in the same things a rare joint atrophy, implying curious abnormal nerve-influence; a leprous nodule, whose history, if we knew it, would reach back through the lazar-houses of the middle ages to the far east, and whose bacilli may be the lineal descendants of those that vexed Naaman the Syrian; a case of microscopes illustrating the development of that instrument, from the first rough iron tube of the spectacle-maker of Nuremberg, to the delicate and complicated instrument through which we now peer curiously into that world which lies within the world of unassisted vision. By our labels and catalogues we must tell men what to see, but to do this we must first see ourselves. The aphorism that a first-class museum should consist of a series of satisfactory labels with specimens attached, means a good deal. Something has been done in this direction, as you will see on inspection of the cases; but I often wonder what sort of labels a man who has spent years in investigating the normal and abnormal structure and relations of one organ would write for our specimen of that organ. Such help as this we need, — kindly, truthful criticism, the pointing-out of errors and of new points of view for this mass of material.

"We also need a series of printed catalogues. One of these should be in the form of compact handbooks relating to particular sections of the collection, and intended partly for the use of visitors while in the museum, and partly as a ready means of letting distant friends know what material it most needs in different departments. It should also print a complete illustrated catalogue of the whole collection, for the use of the investigators and teachers of the profession. Congress has been requested to grant authority for the printing of such a catalogue by the government printer. The material for it is nearly ready, and it would make three volumes, each the size of one of the volumes of 'The Medical and Surgical History of the War of the Rebellion.'"

A BIBLIOGRAPHY OF METEOROLOGY.

AS the literature of the several branches of science is increasing in volume, new scientific journals springing up every month, and valuable material being published in popular serials, bibliographical work comes to be an absolute necessity. This accounts for the numerous attempts at indexing the existing literature, and thus economizing the valuable time of scientists. A bibliography of any branch of science, once published, becomes the most fruitful source for further progress, as it is only thus that existing researches can be profitably made use of. Duplication of old work is avoided, and the compilation of the existing literature on a certain problem, which, without such an aid, is a source of indescribable annoyance and waste of time, is made easy. It is particularly in great scientific institutions, whose collaborators are numerous and frequently stationed in distant places, that, by the help of bibliographies of this kind, a large amount of labor and money is saved, the funds appropriated for their publication being thus well invested. The benefit to the advancement of science accruing from complete bibliographies is self-evident, and we need not dwell upon it.

The scientific bureaus of the United States Government have always been well aware of these facts. The great subject-catalogue of the Army Medical Museum, the bibliographies of the United States Geological Survey and of the Bureau of Ethnology, as well as those published by the Smithsonian Institution, testify to this; and their value is highly appreciated by all students, and has greatly aided the progress of science.

In this connection we may mention the 'Index to the Literature of the Spectroscope,' by Alfred Tuckerman, and that of the literature of columbium by Frank W. Traphagen, published among the Smithsonian miscellaneous collections. In an introduction to the former, Professor Langley well says, "With the rapid accumulation of scientific memoirs and discussions, published from year to year in numerous journals and society proceedings, a constantly larger expenditure of time and labor is required, by both the investigator and the student, to learn the sources of information and the condition of discovery in any given field. Hence is felt the growing need of classified indexes to the work done in the various fields of research, and hence the growing tendency of the age to supply such demand."

The great scientific societies consider these subjects among those calling for the most careful and immediate consideration; and thus the second of the bibliographies mentioned above sprung from the recommendations of the committee on indexing chemical literature, of the American Association for the Advancement of Science.

In meteorology the want of a bibliography is sorely felt. It is therefore with great gratification that we learn of the completion of the 'Signal Service Bibliography of Meteorology,' — a work anxiously looked for by all meteorologists and geographers. In its present form, it consists of a card-catalogue, which is in use in the bureau of the Signal Office. In his last annual report, General Greely, the chief signal-officer says, —

"The practical value of such a bibliography has been fully shown by its constant use in current office-work, and, in addition to the

official demands, almost daily calls for information have been received from parties not connected with the service. The result of this work is the collection of special bibliographies, which insures those consulting it a complete index of what has been accomplished in each special line of meteorology. As has been well said, the progress of meteorology is retarded, and labor therein wasted, owing to the impossibility of ascertaining what has been done in its various branches, — an experience which, as scientific men well know, is by no means confined to this science. The cost of time and labor to the government for the preparation of this work cannot be less than from twelve to fifteen thousand dollars; and the result of these labors has been the completion of a work which is of great value, both practically and scientifically, to the entire world. The catalogue in its present condition is valuable, and sufficient for the pressing needs of this service; but to view it in this light would evince a narrow and selfish disposition not in keeping with the scientific spirit of the age. At a cost of probably eight or ten thousand dollars, this work can be printed and distributed to the world as a monument and evidence of the growing scientific tendency of this nation. If such action is taken by Congress, the chief signal-officer has no doubt, from the willing spirit and hearty co-operation shown by leading scientists of other countries, that future international co-operation will secure by a system of rotation, from the various European governments, the publication of a series of supplements which will keep the world abreast of the steadily increasing volume of meteorological publications. A large number of American and foreign meteorologists and librarians have given largely of their time and energy in the compilation of this bibliography, as is shown by the fact that over one-half of the material has been contributed from foreign countries; so that the bibliography represents not only a large expenditure on the part of the United States, but also many years of additional gratuitous labor. The material could not be duplicated, and it would seem but a respectable reciprocity of exchange that the government should print the catalogue, so as to enable the voluntary contributors to avail themselves of the complete work. This fulfilment of obligations to contributors by a public catalogue is an act of justice; but, in addition, it should be considered that this bibliography will be of great practical value to the agricultural, commercial, engineering, and medical interests not only of the United States, but of the world."

The plan of this bibliography originated with Prof. Cleveland Abbe, who, in 1872, began a systematic collection of works bearing upon meteorology. Later on, he brought the matter to the attention of the leading European meteorologists; and at the meeting of the first meteorological congress, as well as at those of the international meteorological committee, it was indorsed, and steps were taken to carry out the plan. Dr. Hellmann and G. J. Symons were engaged in similar work; and at the Berne meeting of the international meteorological committee in August, 1880, letters of Dr. Hellmann were read, dated Jan. 20 and July 20, 1880, giving a detailed scheme for combining the various works and for the preparation of a catalogue, and embodying Mr. Abbe's proposal of August, 1879, as well as a similar one from Mr. G. J. Symons of London. The committee, however, resolved that each country be requested to furnish lists of observations, and that Messrs. Scott and Hellmann be a sub-committee to consider the means of carrying out Dr. Hellmann's scheme.

In the fall of 1881, Mr. Abbe wrote to Mr. Symons for more details as to his work. General Hazen, chief signal-officer, then decided to purchase the catalogues of both these gentlemen, with a view to their combination and completion by the Signal Office in case the international committee did not do this. In November, 1881, Mr. Symons was authorized to prepare, at the expense of the Signal Office, a copy of all meteorological titles in his collection; and in December, 1881, Mr. Abbe's cards were purchased.

Mr. Symons's catalogue was received in October, 1883; and on March 4, 1884, Mr. C. J. Sawyer, librarian of the Signal Office, was relieved from the care of the library, and, as bibliographer, ordered to devote his whole time to the completion of this work, which was then transferred from the library to the study-room division of the Signal Office.

At the second meeting of the international meteorological committee at Copenhagen, in August, 1882, Messrs. Scott and Hellmann reported that the Meteorological Office could not print the proposed catalogue, and that subscriptions were not practicable. They therefore recommended each meteorological service to publish a national bibliography, for which Hellmann's 'Repertorium der deutschen Meteorologie,' prepared in accordance with the ideas of the committee, and now just about to be published, should serve as a model. It need only be added that since 1882 the international meteorological committee have, with other meteorologists, acquiesced in the arrangement by which the Signal Service has undertaken to complete, and if possible publish, for its own and for general use, a general index to the literature of meteorology.

Up to April 12 of this year, Mr. Sawyer has been engaged on this bibliography, and his estimate of the number of independent titles, including the year 1881 (which date was adopted as the close of the bibliography), is fifty thousand. At that time he had finished the classification of these titles by subjects, and most of the subclassification, the author-index, etc.

Publications later than 1881 and prior to 1887 have been indexed, and will form a supplement, the work on which is almost completed.

So far, no provision has been made for the publication of this valuable work. The scientific as well as the practical value of the bibliography is so great, that its speedy publication is very desirable, even setting aside the danger of its being lost by accident to the building in which it is deposited. Once printed, it will result in a saving of time many times as great in value as the money required for its publication. Professor Abbe's endeavors have succeeded in making it a work of great magnitude, and one that will reflect the greatest credit upon the scientific and practical value of the work of our Signal Service.

SCIENTIFIC NEWS IN WASHINGTON.

Phenomenal Hot Wave and Mortality in Egypt. — Supplementary Reading in Public Schools. — The Annual Ring in Trees. — Temperance-Instruction in the United States.

Phenomenal Hot Wave and Mortality in Egypt.

THE United States consul-general at Cairo, in a despatch dated July 23, describes a condition of affairs, meteorologically, in Egypt this summer, that is really remarkable. He says, "On the night of the 15th of June a heat-wave spread itself over Egypt, and it has since remained continuously. In a residence of three summers here I have experienced nothing comparable to it. The days have given air like that from the blast of a fiery furnace, while the nights have been intolerable from heat. The death-rate throughout Egypt, which was already very high, suddenly mounted towards figures of decimation, and the destroyer has been reaping a great harvest of the dead. For the first week of this very hot weather the death-rate rose in Cairo from a little over 40 to 76.8. The next week it was 71.6; the next 79.1, succeeded for the fourth week by 77.7. These figures present the average. In Bodlac and Darb-el-Ahmar, two quarters of the city, the death-rate was respectively 103 and 86.5, in one case more than decimation, in the other very nearly decimation. Truly no Indian death-rate, except in periods of widespread and most fatal epidemics, reaches the present record in the Egyptian capital.

"For five years past the health of Cairo has been growing worse, and yet during these years a special detail of English sanitary experts has been supervising a khedival sanitary department, the main object of which has been to look after the health of the most crowded Egyptian communities. The sanitary administration costs the Egyptian Government annually about two hundred thousand dollars, not inclusive of publications and police service. The health of the large cities grows worse every year. The heavy summer death-rate begins earlier in Cairo than in Alexandria. Just now a decidedly increased mortality is prevalent in the latter, and, following precedent, it will be much greater in August. Last year the death-rate at one time in Alexandria was about equal to what it now is in Cairo. In some of the smaller cities the mortality has this year been greater even than the Cairo average, and about Damietta there has been typhus-fever of a very fatal character. The rise of the Nile produces great humidity, and during August,

September, and October no abatement of sickness may be hoped for. By the first of November a pleasing change comes, and from then until in the spring the temperature will be mild, the climate delightful, and health, for Egyptians, fairly good. It is gratifying, even under this burning sun and in hearing of these never-ending songs of death, to know that a season will come against which but few if any complaints may be entered.

"July 25. — The average death-rate for the week ended July 19, as shown in the health bulletin, reaches 97.2, while in Darb-el-Ahmer quarter it amounted to 126, and in Bodlac quarter to 100. Total deaths in this city were 685.

"The average maximum temperature for the same week was $106\frac{1}{2}$° F.; extreme heat, $114\frac{1}{2}$°. The average minimum temperature was $72\frac{1}{2}$°; the extreme minimum, $72\frac{1}{2}$°. The observations are taken at the Khedival Observatory, at Abbaseieh, two miles north of Cairo, where the unobstructed sea-breezes produce a lower temperature than in the city or south of it. Were it not for the great relief in temperature at night, existence would be unendurable."

Supplementary Reading in Public Schools.

With the single exception of industrial training, says the editor of the miscellaneous discussions that will accompany the forthcoming report of the United States commissioner of education, no innovation has been made in the schools within the last few years for which so much is claimed, and from which such far-reaching results are expected by practical educators, as supplementary reading. To form a taste for good reading, and thus overcome the evil influences of pernicious, cheap literature, is the highest object which it is hoped to secure; but, apart from this, the use of the works of standard authors in connection with the regular readers, furnishes, according to the testimony of many superintendents, an excellent means of testing the pupils' ability to read understandingly, and at the same time imparts an interest to school-work which nothing else can. In some cities not only standard books, but instructive and entertaining periodicals, are provided. This is the case at Canton, O., where the effects are thus described: —

"These periodicals were used for class-reading supplementary to the text-book, thus giving freshness, additional interest, and instruction in the reading-exercises. Pupils were allowed to take the papers home for evening reading, and were also permitted to use them during school-hours, providing they had any spare time after the preparation of their lessons. The teachers find this school literature a valuable help in moral instruction and in the intellectual culture of the pupils. Providing reading-matter so elevating in tone and so attractive is the best and surest way of overcoming the habit of reading the trashy, demoralizing literature of the day. There is marked improvement in taste for reading noticeable in many instances. Some pupils who were formerly addicted to dime novels and other sensational reading have voluntarily abandoned that since we are furnishing them something better. A knowledge of history, of current events, of familiar facts in science, and language-culture, are some of the benefits resulting from this work."

At San Francisco, Cal., "the principals as a unit want supplementary reading-matter."

The school committee of Southbridge, Mass., say, "Supplementary reading, which has been gradually gaining ground for the past three years, is one of the most advantageous results of the system of free text-books. Its beneficial effects are plainly visible."

From Steubenville, O., comes the following: "Supplementary readers have now been in use long enough to enable us to judge of the results. These are very satisfactory. The children can read in any book of the grade of their reader, and not merely in the one which they have learned by heart from hearing its lessons read over and over, as was so often the case when but one reading-book was used in a grade, and the reading is far better in every respect."

In New Haven, Conn., "the method of teaching pursued requires much independent reading by pupils, and so the habit of reading is formed. Moreover, as supplementary to the school reading-books, standard authors are being introduced, and are read somewhat critically. We can well afford to teach a little less of arithmetic, if by so doing we can insure a love of good books, and a habit of reading that shall be a life-long benefit."

The report of the committee on books and supplies at Lowell, Mass., mentions the subject thus: "With regard to supplementary reading for the different schools, a very small quantity was purchased, though, had your committee acted according to its inclination, a generous sum would have been expended in this direction, as it is assured of the good resulting from a plentiful supply of choice and suitable reading-matter for all the different classes."

The Washington, D.C., teachers are told that "the supplementary books, to be read at sight, are second in importance only to the text-books. They should be used at least for one exercise each week. This part of the reading will show the practical results of the efforts of the teacher and pupils."

The New York City superintendent says, "The good that has been already accomplished by these supplementary readers suggests a more comprehensive application of the same general idea."

A number of titles have been lately added to the list of books authorized for use as supplementary readers in the Boston, Mass., schools.

At Bay City, Mich., a pupil must carefully read at least two books of a prescribed list before he is entitled to promotion to the next higher grade.

The opinion of Mr. George Howland, superintendent of the Chicago schools, is thus expressed: "One of the most serviceable aids in the teaching of reading, enriching the pupil's vocabulary, widening the range of his thought, and strengthening his grasp of words and their meaning, is a wise use of the supplementary readers which to a limited amount have been in use in our schools for four or five years. With these books, in which most of the words, though familiar, are employed in other relations, with a few new words interspersed, the forms and meanings of the words are more permanently fixed in the mind, the alertness of thought in seizing upon the new words greatly quickened, and an ever-increasing interest and power, both of thought and expression, secured, admitting the pupils to more fruitful fields in the domain of history, literature, and science. No outlay of money, I think, can be more usefully incurred than in furnishing a sufficient amount of well-selected books for supplementary reading."

The Annual Ring in Trees.

The second annual report of Prof. B. E. Fernow, chief of the division of forestry, Agricultural Department, has just appeared. It is full of interesting information and suggestions. The following interesting extracts are made from a brief discussion of the annual ring of trees: —

"We may touch here only briefly upon the influence of the annual ring, and that especially for the purpose of asserting the existence of the latter as such in all timber grown in the temperate zone, and to call attention to the difference of structure of the annual ring in different groups of timbers, as from the appearance of the annual ring alone the quality of the timber may be judged to some extent. In this the following three factors are to be taken into consideration: the absolute width of the rings, the regularity in their width from year to year, and the proportion of spring wood to autumn wood. The spring wood is characterized by less substantial elements (vessels of thin-walled cells in greater abundance), while the autumn wood is formed by thicker-walled cells, which therefore appear of darker color. In the wood of conifers, and in that of deciduous-leaved woods in which the vessels (appearing as pores on a transverse cut) are most frequent in the spring wood, the annual ring is usually very distinctly visible; while in those woods which, like birch, linden, maple, etc., have the pores (vessels) evenly distributed throughout the annual ring growth, the distinction is not so marked. Sometimes the gradual change in appearance of the annual ring from spring to autumn wood, which is due to the difference of its component elements, is interrupted in such a manner that seemingly a more or less pronounced layer of autumn wood can be recognized, which again gradually changes to spring or summer wood, and then finishes with the regular autumn wood. This irregularity may occur even more than once in the same ring. Such double or counterfeit rings, which can be distinguished from the true annual rings by a practised eye with the aid of a magnifying-glass, have led to the notion that the annual rings are not a true indication of age. The cause of such irregularity may be sought in some tem-

porary interruption of the vigorous functions of the tree, induced by defoliation, for instance, or by extreme climatic conditions, such as sudden changes of temperature, cold days followed by sudden warm weather, or droughts followed by rain.

"The absolute breadth of the annual ring depends on the length of the period of vegetation; also, the deeper and richer the soil, and the greater the influence of light upon the tree, the more of formative material can be produced by the tree, and the broader will be the annual ring.

"In coniferous wood the width of the autumn wood, with cells of thickened walls, is almost the same in width as in narrow annual rings, while the more porous spring wood changes in width with the general width of the annual ring. Consequently, on account of the more frequent occurrence of heavy autumn wood in a given volume of narrow-ringed wood than in that of wider-ringed wood, such wood is heavier, and, as a rule, narrow-ringed conifer wood is the better. And, with certain limitations, the opposite is true for broad-leaved trees which have their vessels chiefly in the spring wood, while those with the vessels distributed through the ring are less influenced in their weight and quality by the width of the annual ring. Slow-grown conifers and quickly-grown hard woods furnish, therefore, as a rule, the best quality.

"Besides the temperature of the atmosphere and the moisture conditions of the soil, it is the amount of light and consequent development of foliage which is perhaps the most powerful factor in wood-formations, other considerations not being unfavorable. In the proper use of this factor mainly has the forester the means of regulating the slower or quicker development, and consequently the quality of his crop."

Temperance-Instruction in the United States.

In the autumn of 1887 the Bureau of Education at Washington, desirous of obtaining a knowledge of the present status of temperance-instruction in the United States, addressed the following inquiry to the State superintendents: "Is the study of physiology and hygiene with special reference to the effects of stimulants and narcotics required by law, and in what grades?" From the replies it appears that instruction in physiology and hygiene with special reference to the effects of stimulants and narcotics is made compulsory by statute, in some part of their school-life, on all pupils in twenty-five out of the thirty-eight States; viz., Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Delaware, Maryland, West Virginia, South Carolina, Florida, Alabama, Michigan, Wisconsin, Minnesota, Iowa, Nebraska, Kansas, Colorado, Nevada, Oregon, and California. The same compulsion exists in all the Territories and in the District of Columbia by United States statute. In Missouri the instruction under consideration is compulsory upon the demand of patrons of the public schools, and forbidden otherwise.

HEALTH MATTERS.

Seasickness.

NEW remedies for the prevention of seasickness continue to be brought forward. At a recent meeting of the Academy of Medicine of Paris, M. Bonnet presented the claims of antipyrine as a preventive. It was suggested, that as delegates from the academy to the meeting of the French Association for the Advancement of Science, to be held at Ivan, Algeria, were soon to sail for that place, an excellent opportunity to test the drug would thus be offered. M. Rollet, who went with the delegates, and who was exempt from seasickness, made a careful study of the subject, and contributes the results to the *Bulletin Médical*. The vessel sailed at four o'clock, and at six only four of the passengers remained at the table to finish dinner, although sixty had taken antipyrine, some of whom had begun the treatment three days before. He reports that antipyrine has no effect on seasickness.

In a previous number of *Science* we referred to another means to be adopted for the prevention of seasickness: to rub vigorously with the fingers the prominences behind the ears. An opportunity recently occurred to partially test this method. A party went for bluefish thirty miles off Sandy Hook. Two of them, at the first approach of the sickness, practised the rubbing and escaped; a third ridiculed it until thoroughly sick, and then gave it a trial, but without result; the others in the party were not sick, and of course had no occasion for the use of any preventive.

Still another remedy is oxalate of cerium. In a letter to the *New York Medical Record*, Dr. M. M. Waldron of Hampton, Va., writes, "The value of oxalate of cerium in seasickness has been known to me for years. Its application to this condition suggested itself from its supposed physiological action. . . . After repeated experiments on myself and others, I am satisfied that it will relieve more cases of seasickness than any remedy yet suggested. I have tested its efficacy both in coast and transatlantic voyages. Last summer I crossed the ocean with a party of friends. One of the number proved perverse, and would not take the remedy I offered. As the passage was somewhat rough, she was rewarded by being confined to her state-room during nearly the entire voyage. Another member of the party, hitherto a hopeless victim of seasickness, who had, in crossing the ocean fourteen times, made use of every known remedy without benefit, obtained decided relief from the oxalate of cerium. Two others, not 'good sailors,' took it regularly, from the time of going on board until the motion of the steamer ceased to be unpleasantly suggestive, and were kept from any serious symptoms, omitting, in all the passage, but one meal on a stormy night. The best results were obtained by fifteen-grain doses given every two hours. It can easily be taken dry on the tongue, and I belive this mode of administration is most effective."

Writing on this same subject to the same journal, Dr. W. H. Gardner, U.S.A., says, "I have been a traveller by land and water ever since I was able to toddle around, and have met many cases of seasickness, — in stages, ambulances, cars, boats, and ships, — and I can confidently assert that oxalate of cerium, administered in ten, fifteen, or twenty grain doses every two or three hours, in about one tablespoonful of water, will cure more cases than champagne, bromide of potassium, chloral, or any thing else I ever tried. I do not think I exaggerate when I state that it will cure, or materially relieve, seventy-five per cent of all cases that come up for treatment. . . . I have used the oxalate in hundreds of cases of sick-headache, and almost always with marked success; but it must be used in at least ten-grain doses for adults, to do any good. I have also found it very useful in relieving the cough of phthisis in these doses. I do not pretend to know its *modus operandi*, but believe it acts as a sedative to the pneumogastric and sympathetic system of nerves, and I have never seen any unpleasant effects from its administration in twenty-grain doses every three hours."

WARM AIR AT NIGHT. — Dr. Shepherd expresses in the *Lancet* the belief that consumption is due to a constant irritation of the air-passages, and that cold air breathed at night is one of the greatest irritants. Those who live most of the time in the open air are the least likely to suffer from phthisis, because their lungs are so accustomed to cold air as not to be irritated by it at night.

DISPOSAL OF GARBAGE IN BUFFALO. — A company has been incorporated at Buffalo for the purpose of manufacturing grease and fertilizers from the city refuse. The Vienna system has been adopted, and from twenty-five to fifty men besides teamsters will be employed. An ordinance requiring the separation of ashes and swill from garbage will be enforced, and the company will provide garbage-boxes, and collect, clean, and return them. The garbage will be removed in air-tight boxes and vehicles, and the factory is not expected to be in any way a nuisance.

CREMATION OF GARBAGE. — The Minneapolis Board of Health, after a study of the methods of garbage-disposal in Nashville, Chicago, and Milwaukee, has decided to construct a crematory for the burning of the garbage of that city. The furnace is expected to be smokeless, and to consume all solids and liquids. It is of a reverberatory construction, and receives the garbage on a grate some distance above an iron bottom plate that is intended to intercept and consume any falling material. The iron smoke-stack is to be one hundred feet high. The furnace is represented as no more of a nuisance on any street than a well-regulated livery-stable would be. In default of available municipal funds, the board of health has raised the necessary money among the citizens, and secured a remission of royalty upon the patent furnace. In connection with

the subject of garbage-cremation we note that the crematory at Milwaukee has been complained of as a nuisance, the odors from it being a cause of great annoyance.

COLOR-AUDITION. — Mr. J. A. Maloney, otacoustician, of Washington, D.C., communicates to the *New York Medical Journal* the results of some experiments which he has recently made with reference to the conductivity of sound-vibration by the bones of the skull. For this purpose the bone was clamped in a standard which was rigidly affixed to a base of iron weighing sixteen pounds. At one end of the bone was placed in light contact a button suspended upon a rod having a curved projection at its top to allow the button to swing clear of its support. The other end of the bone was gently struck with a small hard-rubber mallet, and the space through which the button was projected noted. The results upon different bones were as follows: frontal, very hard blow, slight disturbance of ball, without projection; occipital, the same; parietal, the same; ethmoid, less than the former; sphenoid, a very slight tap on one great wing gave great projection from the other wing, and scratching with or rolling of the mallet over the surface of one wing caused the button impinging upon the other to be agitated. The sphenoid was then made to communicate its vibrations to the diaphragm of a microphone in electric circuit with a telephone-receiver. In this test a very fine thread of silk, held at one end, was drawn lightly over the free wing, and the same could be heard distinctly in the receiving-telephone. Breathing gently through a tube against the wing would be heard in the receiver. The temporal bone was then substituted for the sphenoid; and the only point which gave results similar to that of the sphenoid was when the two tests were made upon that portion of the petrous or pyramidal process known as the jugular fossa. Mr. Maloney asks, May not color-audition, in view of the readiness with which the sphenoid bone takes up and delivers vibrations, be due to mechanical stimulation of the optic nerve by impingement of the same upon the sphenoid bone in its passage through the optic foramen? The phenomenon of color-audition was first brought to the attention of the scientific world by Dr. Nussbaumer of Vienna, who, when a child, was engaged with his brother one day in striking a fork against a glass to hear the ring, when he discovered that he saw colors at the same time that he perceived the sound; and so well did he perceive the color, that, when he stopped his ears, he could divine by it how loud a sound the fork had produced. Dr. Nussbaumer was afterward able to add to his own observations nearly identical ones made by a medical student in Zürich. Later on, M. Pedrono, an ophthalmologist of Nantes, observed the same peculiarities in a friend. In these cases musical sounds gave sensations varying the color according to the instrument played upon, thus showing the dependence of the phenomenon upon the timbre. For instance, the saxophone gave yellow sensations; the clarionet, red; the piano, blue. When numbers and words were used, the following results were obtained in cases mentioned in an article, 'Color of Words,' by E. A. Newell (*Popular Science Monthly* for December, 1887): 1, black; 2, light cream; 3, dark cream; 4, brownish red; 5, black; 6, tan-color or cream; 7, greenish black; 8, dark straw; 9, mud-color; 10, black; 11, black and straw; 12, light cream; 13, dark straw-color; 14, light brown. Following are some familiar names, and the color of each, and also the letters of the alphabet: Mary, dark red; Abbie, tan; Lucy, dark blue; Richard, light gray; Atlanta, steel-gray; Charlotte, light red; Claire, light blue; Newcomb, dark red; Lincoln, black; Morse, brown; A, light straw; B, gray; C, tan; D, blue; E, black; F, black; G, light straw; H, red; I and J, black; K, blue; L, black; M, brown; N, dark blue; O, light red; P, light green; Q, blue; R and S, light straw. Henri de Parville, in the *Popular Science Monthly* for August, 1883, and previously in *Le Monde de la Science et de l'Industrie*, says, "Popular expressions are often significant. 'I saw three dozen lights of all colors,' or some such expression, may frequently be heard from persons who have received violent blows on the head or face. Under the influence of shocks of this kind, the eye seems to see infinite numbers of sparks. Shocks of a certain class impressed upon the nervous system seem to have the faculty of producing phenomena of light. There are persons endowed with such sensibility that they cannot hear a sound without at the same time perceiving colors. Each sound to them has its peculiar color: this word corresponds with red, and that one with green; one note is blue, and another is yellow."

ETHNOLOGY.

Tattooing.

MISS A. W. BUCKLAND, in the *Journal of the Anthropological Institute* of Great Britain, publishes a study of the distribution of the custom of tattooing. Although her list of tribes who practise this custom might be considerably increased, some of the results of her study are of great interest. She distinguishes two methods of tattooing. In the one, cuts are made in such a manner as to leave a scar; in the other, patterns are pricked out, and coloring-matter is rubbed into the wounds. According to Miss Buckland, the former method, which she calls 'gashing,' is confined to Africa (excepting Egypt), some parts of southern Europe, and Australia, including a few of the neighboring islands. Tattooing, in the proper sense of the word, is practised in Polynesia and all over the American continent. The most beautiful patterns are found in New Zealand and among the lower classes of Japan. The author calls attention to the widespread custom of marking the chins of women as denoting marriage. The distribution of the custom of tattooing is more fully illustrated in Gerland's excellent ethnological maps, which are being published in Berghaus's 'Atlas of Physical Geography.' He distinguishes between tribes tattooing both sexes and those tattooing the women alone, which is most extensively practised by the natives of Arctic America and the east coast of Asia. The student of this problem will find material of the greatest value in W. Joest's work on tattooing, gashing (or, as he calls it, 'drawing by means of scars'), and painting the body. The plates, which form the most important part of the work, are beautifully done, and deserve the more praise, as they must be considered absolutely reliable. Joest emphasizes justly that it is necessary to take the most painstaking care in reproducing ornaments of this kind. It is necessary for the artist to understand the intentions of the native tattooer or draughtsman, in order to render his work correctly. As this precaution has frequently not been taken by travellers, many drawings of works of native art are mere caricatures. Fortunately the necessity of the greatest care in making collections of this kind is well understood at present. Joest arrives at the conclusion that tattooing has no connection whatever with the religion of the tribes who practise it, but that it is chiefly ornamental. Miss Buckland is of a similar opinion. She says that tattooing is generally ornamental, and that it seems to be in the men honorable, denoting bravery in battle. Tattoo-marks are, as a rule, geometric designs. There are only a few tribes known among whom conventionalized animal forms are used, denoting the totem of the bearer. Among these are the Haida of the Queen Charlotte Islands, the tattoo-marks of whom were first described by Swan. Several of their neighbors practise the same custom. Joest's book contains a partial bibliography of this subject. The etchings and plates which accompany his book refer principally to Melanesia and Polynesia; but, besides this, tattooing from Tunis, a beautiful specimen from Japan, and several from Central Africa and Burmah, are given.

A RECENT DISCOVERY IN EGYPT. — Prof. A. H. Sayce, in the August number of the *Contemporary Review*, describes an archæological discovery of great interest, made recently in upper Egypt, where a large collection of clay tablets, inscribed with cuneiform characters of a cursive Babylonian form and in the Babylonian language, have been found at Tel el-Amarna. They consist, for the most part, of letters and despatches sent by the governors and kings of Palestine, Syria, Mesopotamia, and Babylonia, to two Egyptian monarchs, Amenophis III. and Amenophis IV. Five of the letters are from Babylon, the date being about B.C. 1430, which approximately fixes the period to which the reign of Khu-en-Aten must be assigned; but the largest number refer to the mother of the latter, who was the daughter of the King of Naharina. This place is proved by the tablets to be situated on the eastern bank of the Euphrates. The unexpected revelation of active literary intercourse from one end of the civilized East to the other, in the century before the date assigned by Egyptologists to the Exodus, is likely to produce a revolution in our conceptions of ancient Oriental history. It

is needless to point out what an interest it possesses for the student of the Old Testament, or what important bearings it is likely to have upon the criticism of the Pentateuch. The most unexpected part of the discovery is the fact that the medium of literary correspondence was the Babylonian language and script. It is true that here and there we come across evidences that the writers were not of Babylonian origin, as when the king is called a 'sun-god,' in accordance with Egyptian ideas, or when the first personal pronoun is expressed by the Phœnician *anuki* instead of the Assyro-Babylonian *anaku*. But the language of Babylonia is generally correctly written, and the scribes show that they had acquired a very thorough knowledge of the complicated cuneiform syllabary. It is evident not only that good schools existed throughout western Asia, but an acquaintance with Babylonian literature as well. We can now explain the presence of the names of Babylonian deities, like Nebo or Rimmon, in Canaan, as well as the curious resemblances that exist between the cosmologies of Phœnicia and Babylonia. Perhaps the most important result of the discovery is the evidence it affords us that some parts, at any rate, of the books preserved in the libraries of Canaan, were written in cuneiform characters, not upon papyrus, but upon imperishable clay. There is therefore some hope that when the excavator is able to exhume the buried relics of cities like Tyre or Kirjath-Sepher, 'the town of books,' he will find among them libraries similar to those of Assyria or Babylonia. Not only do we now know that the people of Canaan could read and write before the Israelitish conquest, we also know that they wrote upon clay. The 'scribes' mentioned in the Song of Deborah (Judges v. 6) have become to us living realities. The discontinuance of the old literary intercourse, and of the international language and script which accompanied it, must have been due to the advance of the Hittites and their long wars with the Egyptians, followed by the Israelitish invasion of Palestine. Western Asia was for a time a scene of bloodshed and disorder; Egypt had fallen into decay, and the cultured populations of Canaan were struggling for life and home. On the north were the Hittite tribes; on the south, the children of Israel. When order began to reign again, the influence of Babylonia had passed away, and its cumbrous syllabary had been superseded by the simple Phœnician alphabet. The date at which this was introduced into Phœnicia has now to be fixed by the progress of archæological research.

ELECTRICAL SCIENCE.

Disruptive Discharges and their Relation to Underground Cables.

THE paper read by Mr. E. G. Acheson before the National Electric-Light Association, on the above subject, was the most valuable contribution to our knowledge of underground cables that was given at the last meeting of the association. The object of the experiments described by Mr. Acheson was to find out under what circumstances the insulation of a wire carrying a high-tension current would be pierced by a spark. Some previous experiments on the discharge between points in air led to the equation

$$d = \frac{(\text{E.M.F.})^3 \times (\text{Capacity})}{a},$$

where d is the spark-length, and a is a constant for the dielectric, the capacity being expressed in micro-farads. For air, a was taken as 135, and d was expressed in inches. As the conditions which actually occur in practice are not discharges between two points, but between the cylindrical surface of the wire and some point outside the insulation, experiments were made to determine the value of a with this arrangement and with different dielectrics. The results give, in general, a greater value of a than when the points alone are used.

Dielectric.	Spark between.	a
Air	Points	135
Air	Point and wire	263
Paraffine and cotton	Point and wire	5,822
Ozite and cotton	Point and wire	7,759

To find what effect cracks in the insulation would have, Mr. Acheson took a broken plate of glass, the two parts of which were held firmly together. With a high electro-motive force, there was no discharge between two points on opposite sides of the glass when the solid part of the plate was between; but, when the points came abreast the crack, there was a spark. Another interesting experiment showed that a disruptive discharge, due to the breaking of a high-tension cable, would rather go through the insulation than through an electric arc.

To avoid any chance of a disruptive discharge through the insulation of the cable, especially if the latter be lead-covered, Mr. Acheson suggests that a wire be twisted around the outer lead covering, and the point be brought near to the bared surface of the conductor, the distance between them being adjusted until the discharge would pass between the conductor and the point rather than through the insulation.

In concluding his paper, the author says, "It is safe to predict, that, the disruptive discharge being provided for, little or nothing more would be heard of the much-talked-of pin-holes in the lead, and the moisture-absorbing terminals; the undergrounding of arc-light cables would become a thing of certainty, and our municipal governments relieved of a great bugaboo.

THE RECHNIEWSKI ALTERNATE-CURRENT MOTOR. — The adaptability of alternating currents for distributing light over an extended area has led a number of inventors to attempt to devise an electric motor that can be used on such circuits. The motor of Mr. Tesla, which has been described in this journal, is one of the most ingenious attempts in this direction, although there is yet considerable doubt as to its efficiency and regulating properties and its adoption would necessitate a complete change in the present method of distribution. It has been known ever since any attention was called to the subject, that an ordinary series motor would work on an alternating-current circuit, and Mr. Kapp has pointed out that a condition of maximum output is that the self-induction and counter electro-motive force of the motor should be equal. M. Rechniewski's motor is of the inverted Edison type, the field-magnets and armature-core being both built up with thin iron plates. The armature is of the drum type, and is large compared with the field-magnets. No data as to the performance of the motor are obtainable, but the following figures, taken from the *London Electrician*, give some idea of its construction : —

Volts at terminal	115
Current in ampères	100
Revolutions per minute	1,400
Diameter of armature	8 in.
Peripheral velocity in feet per minute	2,800
Weight of iron in field	440 lbs.
Weight of iron in armature	108 lbs.
Section of iron in field	42.5 sq. in.
Section of iron in armature	33.5 sq. in.
Induction in armature	3,700,000 lines.

The motor is not self-regulating, but it can be governed in the same way as some of the continuous-current motors.

MEASUREMENT OF ILLUMINATION. — M. Mascart has invented a photometer that enables him to compare the illumination produced by two sources of light. The standard lamp illuminates a plate of ground glass, an image of which, formed by a lens, is thrown after two reflections on a second plate of ground glass, called the 'test-glass.' The general diffused light of the room to be tested illuminates a translucent screen, the rays emitted from which are reflected at an angle of forty-five degrees, and fall on the other half of the test-glass. The light from either source can be more or less cut off by sectors. In lighting similar rooms of different sizes, it would appear at first that the source of light should vary in intensity with the square of the dimensions. It is found in practice, however, that the quantity of light varies as the cubic contents of the room. We may, from a consideration of the limiting distance at which a source of light ceases to be effective, get an idea of mean illumination. If, for instance, the limiting distance is ten metres, and the mean illumination one carcel at one metre, then the illumination should be .16 of a carcel per cubic metre. Comparing the illumination of public buildings during this century leads to the conclusion

that the public demands a much brighter illumination than formerly, and this increase of illumination has by no means reached a maximum.

A NEW INSULATING COMPOUND. — The following, from the *Electrical World*, is taken from the *Chronique Industrielle:* "The compound is composed of one part of Greek pitch and two parts of burnt plaster by weight, the latter being pure gypsum raised to a high temperature and plunged into water. This mixture, when hot, is a homogeneous viscous paste, and can be applied with a brush or cast in moulds. It is amber-colored, and possesses the insulating properties of ebonite, and can be turned and polished. Its advantage is its endurance of great heat and moisture without injuring its insulating properties."

SPECIFIC RESISTANCE OF MERCURY. — Since the absolute unit of electrical resistance has been defined in terms of a column of mercury of one millimetre cross-section and of a given length, a number of determinations of the specific resistance of mercury have been made. The latest is by Messrs. Glazebrook and Fitzpatrick, and gives for a result that the resistance of a column of mercury one millimetre in cross-section and one metre long is $r = 0.95352$ B. A. units. The other results that have been obtained are —

Observer.	Date.	Value for r in B. A. Units.	Value of Ohm in Centimetres of Mercury at 0°.
Lord Rayleigh and Mrs. Sidgwick	1883	0.95412	106.23
Mascart, Nerville, and Benoit	1884	0.95374	106.33
Strecker	1885	0.95334	—
L. Lorenz	1886	0.95388	105.93
Rowland	1887	0.95349	106.32
Kohlrausch	1888	0.95331	106.32
Glazebrook and Fitzpatrick	1888	0.95352	106.29

ELECTRIC TRAMWAYS IN SALT-MINES. — In the new Stassfurt mine an electric tramway has been in operation since January, 1884. It was built by Siemens & Halske, and was a success from the start. The engine is of 20-horse power, and is placed above ground at the mouth of the shaft. The dynamo is compound wound, and gives about 40 ampères at 300 volts. The current is taken through cables to the tram-line, a distance of 410 metres. The motor is supplied from overhead iron conductors, insulated from the ground. The motor is simply one of the well-known type of Siemens dynamos, placed horizontally on a car to economize space. The dynamo supplies about 20-horse power of energy; the motor gives about 10-horse power, — an efficiency of only fifty per cent. The weight of the wagons to be drawn is about 2,500 pounds, and there are sixteen in a train. The mean speed is about six miles per hour. This line is not in any way so efficient as those that can be put up to-day, but some figures as to the cost of working are of interest, especially as the road has been long enough in operation to allow an accurate estimate to be made. In 1884, 176,196 trucks were handled; and the working cost, including all items, wages, fuel, etc., with fifteen per cent for interest and depreciation, was 10.1 pfennig (about $2\frac{1}{2}$ cents) per truck, while the cost before had been 20 pfennig (5 cents). In 1887 the figures are still more favorable, as the underground electric way had been considerably increased. The cost was 8.3 pfennig (about 2 cents) per truck, or 12.92 pfennig per kilometre ton, as compared with 34.2 pfennig per kilometre ton by human labor, which the electricity displaced. If the few electric tramways in mines that are now in operation in this country were investigated as to cost, it would be found that their economy is as great as that given above. It is only a question of a few years when mule and man power in mines will be replaced by electric motors.

MICHEL EUGENE CHEVREUL, the chemist, entered his hundred and third year on Aug. 30. He is still active, and a few days ago was able to visit the Sanitary Exhibition at the Palace of Industry.

BOOK-REVIEWS.

Eclectic Physical Geography. By RUSSELL HINMAN. Cincinnati, Van Antwerp, Bragg, & Co. 12°. $1.

"THE aim of this book is to indicate briefly what we know or surmise concerning the proximate causes of the more common and familiar phenomena observed at the earth's surface. Even thus restricted, the field of inquiry encroaches to a greater or less extent upon the domains of all the branches of science. Since the study of physical geography precedes that of the sciences in most of our schools, it has been thought advisable to present, in the form of an introductory chapter, a condensed statement of the more important and fundamental scientific conceptions regarding the properties and phenomena of matter and energy, such as inertia, gravitation, cohesion, affinity, and heat, light, magnetism, and electricity."

This passage, taken from the preface, shows the scope and object of the volume under review. The different parts of the subject are treated in the order used in all books of this character. Mathematical geography forms the first part. This is followed by meteorology, oceanology, geophysics, and biology. The book is illustrated by many maps, in which the most recent discoveries and researches have been made use of, and which, considering their smallness, are quite satisfactory, and undoubtedly superior to those defacing most American text-books of geography. In a number of maps the author has preferred to omit the system of meridians and parallels; it seems to us, not to the advantage of these maps. The great number of maps, and the fact that they are copied from the best authorities available, make the book very useful to the student. The chapters on meteorology and geophysics are the best parts of the book, while in that part treating of the oceans we find many statements that are not entirely in accord with the views held by the best writers. We particularly object to the method of the author of describing theories advanced by individual authors, but not generally accepted, — for instance, Murray's theory of the origin of deep-water deposits, and Ferrel's theory of ocean-currents,— as firmly established facts. A book of the character of this 'Eclectic Physical Geography,' if giving as much theory as the present one does, ought to give the views of opposing parties, and not favor one to the exclusion of another. In Part IV. the author gives first an outline of the topography of the earth, which is generally not treated in books of this character. After a brief treatise on weather and climate, the forms of life are discussed. It seems to us that the author, in this the last part, does not do full justice to his subject, his treatment being too brief, and his views not quite clear in all respects. Evidently it is his opinion that the principal part of geography consists in the study of geophysics. The book is, on the whole, well adapted to be used in the higher grades of teaching geography, although it might have been better to treat theories less dogmatically.

The Chemical Analysis of Iron. By ANDREW ALEXANDER BLAIR. Philadelphia, Lippincott. 8°. $4.

IN this book Mr. Blair describes those methods of analysis which, in his extended experience, he has found to be of most value to the iron-chemist. The first twenty-two pages of text are devoted to the description of the necessary and most suitable apparatus; twenty-one pages treat of the re-agents; then follow detailed methods for the analysis of iron and steel, iron ores, limestone, clay, slags, fire-sand, coal and coke, and furnace gases; tables to facilitate the calculation of analyses follow; and the book ends with a very complete index.

The work is well done, the arrangement good, the descriptions clear and to the point, the illustrations excellent. It forms a manual which must prove of the greatest assistance to those entering this field of work, while those who are already familiar with this branch of technical analysis will find it a convenient reference-book, and doubtless gain from it a number of valuable suggestions.

In Fresenius's 'Quantitative Analysis' (sixth German edition) fifty-two pages of the 'Special Part' are given to methods for analyzing iron and iron ores, and Bolley's 'Handbuch' contains seventy-seven pages on the same subject; but this is, so far as we are aware, the first complete work containing between its covers not only all the best methods for the analysis of all materials directly

connected with the iron-industry, but also descriptions of the apparatus and manipulations especially adapted to the work.

A fuller discussion of the advantages and defects of the several methods given for the determination of a single element would have added to the user's satisfaction.

One is surprised to find in a work so excellent a table of atomic weights in which recent recalculations and redeterminations are ignored. According to this table, Al=27.5, Sb=122, Mn=55, Pt=197.18, etc. The error naturally extends to the table of factors, which are calculated on the basis of these atomic weights. Thus the factor for Al from Al_2O_3 is .53398, instead of .53010 as it would be with Clarke's value, Al=27.075 (O=16).

The mechanical execution of the book is, on the whole, superior to any thing we have had the good fortune to see in the way of laboratory handbooks. Heavy, fine paper, admirable press-work, and a party-colored binding make the book pleasant to the eye and hand, and — expensive. It is indeed almost too fine and costly to expose to the rude chance of laboratory disfigurement. It may be, however, that author and publisher hope, through its full-dress appearance, to promote a feeling of greater respect for nicety of manipulation in the chemists into whose hands it may come.

The book is unusually free from typographical errors; but we notice a slip of the proof-reader's on pp. 55, 56, 57, and 63, where the references to Fig. 45 should read H instead of D.

First Lessons in English. By F. B. GREENE. Philadelphia, Cowperthwait & Co. 16°.

ONE of the most difficult studies for most young persons is grammar. A few, whose minds are fitted to readily grasp abstract ideas, learn it easily and with pleasure; but to the majority it is at first irksome, This is partly due to the habit of English grammarians of laying down a mass of rules borrowed from the classical languages, and having but little application to our own tongue; but it is also in part due to the abstract and formal character of grammatical treatises, which are ill adapted to the minds of children. To remove this difficulty and make the introduction to grammar easier, books have been prepared of late years on the inductive principle, and teaching the rudiments of the science by example. Rules and technical terms are very sparingly used, and the pupil is taught the parts of speech and the construction of the sentence in so simple a way that he can hardly fail to understand them. The book before us is one of this class, and, though nothing but actual use in the classroom can accurately test its value, it seems to be well adapted to its purpose. It is illustrated, so as to make it attractive to very young pupils; and the lessons and examples are of the simple character that such pupils need. Such a work is certainly a great improvement on the elementary grammars of former days.

Old and New Astronomy. Parts I.–V. By RICHARD A. PROCTOR. London and New York, Longmans, Green, & Co. 4°.

THE present work, the first instalments of which have reached us, is intended to give an account of the science of astronomy and of its history to the general student. The work is admirably adapted to this purpose, Proctor's theories and arguments being set forth very clearly, and being illustrated by numerous good and very instructive cuts, which pre-eminently enhance the value of the book. In a brief introduction the author states his object. "It is as a subject for study and contemplation as a means for training and exercising, but likewise for ennobling and purifying the mind, that astronomy should be studied by all. It is the celestial science as viewed and studied by philosophers, as Newton and Herschel, that I propose to contemplate in the present volume." In the first chapter the history of the methods of observing heavenly bodies is described, in which discourse Proctor expounds his curious concept that the Egyptian pyramids were nothing else than immense observatories. The development of these methods is traced up to the present time. The next chapter contains studies of the earth's shape. The various proofs of the earth's curvature are explained by novel figures, among which we call attention to the telescopic view of a 'hull down' ship seen indistinctly beyond the sharply defined horizon, thus proving that it is farther distant than the horizon. In the discussion of the sun, moon, and planets, their apparent motions are first treated; and after an exhaustive explanation of the ancient theories, and the paths of the planets relatively to the earth, supposed to be at rest, Kepler's system is described and explained. Of particular interest is Proctor's elementary deduction of the perturbing action of the sun on the moon, which is used in explaining the cause of the tides. The fifth instalment treats of the methods and results of measuring and weighing the solar system. The book is very beautifully printed, and the instalments are following each other very rapidly. The matter is treated very attractively, and the mathematical deductions, which are contained in notes, are so arranged as to be intelligible to anybody who has an elementary knowledge of it.

NOTES AND NEWS.

RICHARD ANTHONY PROCTOR died in this city on Sept. 12, of yellow-fever, which he had contracted in Florida. Proctor was born at Chelsea, England, on March 23, 1837. Early in life he devoted himself to astronomy, and was a very fruitful writer. His first book was on 'Saturn and its System.' In the United States he is largely known to the public through his lectures, which he delivered in most of the larger cities. His first visit to our country was in 1873–74. He was eminently successful as a popular writer, and knew well how to make the difficult problems of astronomy attractive and intelligible to the general reader. His last work, 'Old and New Astronomy,' which is being published, is a splendid specimen of his enthusiasm for his science and of his success in imparting it to his readers.

— The Appalachian Mountain Club plans an excursion to Mount Washington, Mass.; the party, which will be limited to fifty in number, to leave on Friday morning, Sept. 28.

— E. Dubois read recently, before the French Academy of Sciences, a paper on the satellites of Mars which were discovered in 1877 by Asaph Hall. It appears remarkable, that notwithstanding the numerous observations of the planet, and notwithstanding their rapid motion and close proximity to it, they were not discovered sooner. Dubois believes that such would undoubtedly have been the case if they had existed. He expresses the opinion that two of the telescopic planets which occupy the zone between Mars and Jupiter approached the former so near that they have become its satellites. He also says that several others of these bodies may become satellites of Mars in course of time.

— F. S. Mansfield, attaché to the United States Legation in Japan, visited the scene of the eruption of the Bantaisan in Japan, of which a full report was given in the last issue of *Science*. His account, which was printed in the *Atlanta Constitution*, Aug. 26, contains the following additional details: On Sunday, the 15th of July, rumblings were heard and earth-tremors felt in the vicinity of the Bantaisan. The first disturbance noticed occurred at about 7 A.M., and was followed by three earthquake shocks at intervals of ten minutes, when there occurred a loud explosion, the noise of which the people compared to the report of thousands of cannons discharged simultaneously. At 10 A.M. the eruption was at its height, and by 4 P.M. it was over. The Japanese Government has set up a temporary hospital in a schoolhouse for the treatment of the wounded, and has organized a relief committee to look after the homeless and to recover the bodies of those who had been killed. The number of people who lost their lives by the disaster was, according to the official statement from the government relief station at Inawashiro, 518, the bodies of 70 of whom had been found, while 41 persons had been injured, and were then in the hospital at Inawashiro. The eruption occurred on the eastern side of the principal peak of Bantaisan. A portion of the smaller peak was carried away. The mud then filled up the side of the mountain, not only on the eastern side, but on the northern side as well, running down in a stream to the valley below. At the foot of the mountain each stream was about half a mile wide, gradually narrowing toward the top. The main eastern stream was divided about halfway up the mountain by a ridge, and came down in two separate volumes, the one continuing east, while the other branch came down on the southern side of the mountain, the latter stopping in the very small hamlet of Minemura, which was partially destroyed by the mud covering completely some of the houses.

The amount of mud thrown out by the volcano is beyond all calculation, as all the streams reach from the top to the bottom of the mountain, a distance of four or five miles. There was no lava thrown out. The greatest number of lives lost was on the north-eastern side, on account of that side of the mountain being the location of several hot-springs resorts, and owing to the fact that the first discharge ran down on that side. At Nagasaki, a small hamlet near the volcano, a great number of lives were lost by a flood, which it appears was occasioned by the damming-up of the creek on which the hamlet is situated. The darkness which occurred at the time of the explosion extended for some ten or fifteen miles, and very small particles, like mist, fell much further.

— The sealer 'Jason,' says *Nature*, has arrived in Norway from the Greenland coast, and reports that the expedition under Dr. Fridtjof Nansen, which is to cross Greenland from east to west, left that ship on July 17 in latitude 65° 2′ north. An ice-belt about ten English miles in width separated the ship from the shore, but it is believed that the members would have no trouble in crossing this, the floes being large. Dr. Nansen intended to land in the Sermilik Fiord, which is inhabited. Previous attempts at landing had failed on account of rain and fog.

— Paper relief-maps for teachers of geology and physical geography, designed by Prof. William M. Davis of Harvard College, for use in his lectures to students and teachers, are advertised by J. H. Emerton, 11 St. James Place, Boston, Mass. Being made of paper, they are much lighter and stronger than plaster relief-maps, weighing only one or two pounds each, so that they can be held in the teacher's hand, hung on the wall, or used in any position desired. They are large enough to be seen across the largest school-room, — about three feet long, a foot and a half wide, and from two to four inches high. The development of a river in a plain is shown in five maps; the development of rivers in a broken country, in three maps; a river traversing a mountain (Uintah Mountains), in two maps; the development of zigzag ridges (Appalachian Mountains), in two maps; the changes in the rivers of a country, caused by glacial drift (Canadian drainage), in two maps; river-terraces (New-England drainage), in three maps; changes in the position of divides, in three pairs of maps; and a volcano series, in six maps.

— The New York Mineralogical Club took excursions, Sept. 8, to Inwood, N.Y., and Saturday, Sept. 15 (probably the closing trip of the season), to Hoboken, N.J.

— We have received the prospectus of the Massachusetts Society for promoting Good Citizenship, and also a list of works on civil government which its committee on reading recommend. The object of the society is declared to be, "to disseminate a knowledge of the principles of good citizenship, and to promote the observance of the duties imposed thereby," and especially to encourage the study of political history and political philosophy. With this end in view, a committee has been appointed to examine the various text-books and other works on political science, and give the results of their examination to the public. The first of their reports is now before us, and is a description and criticism of works on the national and state governments of this country. The judgments of the committee are thoroughly independent, and, so far as we can judge, judicious. They evidently do not mean to recommend a worthless book; and their comments on the various works examined by them cannot fail to be useful both to teachers and to private students. Persons wishing to join the society may address the secretary, C. F. Crehore, M.D., 87 Milk Street, Boston.

— The October number of *The Chautauquan* contains 'Gossip about Greece,' by J. P. Mahaffy of Dublin University; 'Greece and Modern Civilization,' by Herbert B. Adams and William P. Trent of Johns Hopkins University; 'Solon, the Athenian,' by Thomas D. Seymour of Yale University; 'Greek Mythology,' by James Baldwin; 'The Circle of the Sciences,' by Prof. A. P. Coleman of Victoria University; 'Philanthropy,' by Prof. Richard T. Ely of Johns Hopkins University; 'The Policy of Russia in the East,' by C. K. Adams, LL.D., president of Cornell University; 'Memories of Professor Baird,' by G. Brown Goode of the National Museum; 'Yucatan,' by J. Hendrickson M'Carty, D.D.; 'Engineering Feats in the West,' by Ernest Ingersoll; 'Mound-Making Ants of the Alleghanies,' by Dr. H. C. McCook; 'On a Bronze Buddha at Washington,' by Charles de Kay; and 'The Possibilities of Culture,' by Bishop H. W. Warren, LL.D. —— The September *Cosmopolitan* was published this month on the 10th. Besides its principal attractions, is 'The Adventures of a Lion-Tamer,' a graphic story of Barnum's trainer of wild beasts. —— Prof. Arthur T. Hadley's article in *Scribner's* for October, on 'The Railroad in its Business Relations,' will throw much light on the questions of rates, pooling, and government control. —— The publishers of Worcester's dictionaries, J. B. Lippincott Company of Philadelphia, announce that they have ready an entirely new edition of their 'Academic Dictionary.' While this book is a revision of their well-known 'Academic Dictionary,' so many new features have been introduced that it was found necessary to reset the type entire. The 'New Academic' presents as a new feature the etymology of words. In orthography great attention has been paid to usage, analogy, and etymology in deciding disputable points. In pronunciation the book not only gives the preference of Dr. Worcester, but exhibits at the same time that of the leading lexicographers. The same publishing firm also announce a new edition of the 'United States Dispensatory.' The revision has been thorough, and not merely the addition of a supplement. More than one-third of the book, or nearly eight hundred pages, is entirely new matter, while the whole work has been rewritten. The 'National Formulary' has been incorporated.

LETTERS TO THE EDITOR.

The Corean Potter's Wheel.

THE Corean potter's wheel consists of a circular table from two to three feet in diameter and four to six inches thick, made of heavy wood so as to aid in giving impetus to it when revolving. In general appearance it is not very unlike a modeller's table. This arrangement is sunken into a depression in the ground, and revolves easily by means of small wheels working on a track underneath, the table being pivoted in the centre. The wheel is operated directly by the foot, without the aid of a treadle of any kind. The potter sits squatting in front of the wheel, his bench or seat on a level with it, and space being left between his seat and the wheel to facilitate his movements. With his left foot underneath him, he extends his right foot, and strikes the side of the wheel with the bare sole of the foot, causing it to revolve. P. L. JOUY.

Washington, Sept. 12.

Poison-Apparatus of the Mosquito.

MY former notes on this subject (*Science*, Aug. 26, 1887; *Proceedings of the American Association*, 1887) require amendment in the following respects: (1) the poison-fang is single, being in fact the hypopharynx, as was suspected by Dimmock; (2) the paired branches of the poison-duct run backwards into the prothorax; (3) the secreting-glands are in two paired systems, one system on each side in the prothorax. Each system consists of three trifoliate glands, the mid-gland being poisonous, and the lateral ones salivary; the three ductules uniting into the branch of the poison-duct of its own side. The other details are as before described. G. MACLOSKIE.

Princeton College, Sept. 15.

Answers.

36. DOUBLE FRUIT. — A note in *Science* of Sept. 7 prompts me to say that in 1851 I resided on a lot in this city on which was a large number of fruit-trees, including peaches and plums of several varieties each, with cherry and apple trees. The crop of fruit was very large, and specimens of double fruit were very common on all the trees, including peaches, plums, cherries, and apples. Many of them were but slightly attached at the stem; others, two perfect specimens, attached through their whole length. In the garden double cucumbers were common. Doublets of the same kind were common in the market that season. I cannot answer as to the blossoms, having noticed nothing peculiar about them except their abundance. JOHN J. JANNEY.

Columbus, O., Sept. 16.

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SCIENCE

FRIDAY, SEPTEMBER 28, 1888.

NATURE SAYS, THAT, so far as numbers are concerned, the Bath meeting of the British Association has been below the average. The number of tickets sold has been about fifty less than two thousand, forming a marked contrast to last year's meeting, which beat the record. The diminished attendance has told to some extent on the grants, several of which had to be reduced below the sums originally proposed and approved of. The meeting next year will be presided over by Professor Flower. Among the grants allotted by the general council, the following may be mentioned. For the question of electrical standards £100 have been granted, the Ben Nevis Observatory receives £50, and six smaller amounts have been granted for researches in various branches of physics and chemistry. For the 'Geological Record' £80 have been allotted, and provisions have been made for studying the volcanic phenomena of Japan, the distribution of erratic blocks, and several paleontological and stratigraphical questions. The greatest grants have been allotted to the biological section. The Marine Biological Association and the Naples Zoölogical Station continue to be supported by the association by grants of £200 and £100 respectively. An amount of £100 each has been given to a study of the zoölogy and botany of the West India Islands and of the Friendly Islands. The same sum will be devoted to explorations of the geology and geography of the Atlas Range, and to an investigation of estuaries by means of models. In the anthropological section two important grants have been made, — one for continuing the studies on the north-western tribes of Canada of £150; and another of £100 for exploring the Roman Bath at Bath, a great part of which was excavated last year, and found in a remarkably good state of preservation. Besides this, a number of minor grants have been allotted, the total amount to be expended being £1,645.

THE ORIGIN AND DEVELOPMENT OF LANGUAGE.

THE existence of a great number of independent linguistic stocks offers one of the most difficult problems to ethnology. Numerous attempts have been made to compare apparently separate stocks, and to trace their origin, but there remain a great number which cannot be derived from a common source. The most recent theory on the origin of linguistic stocks is the one offered by Prof. Horatio Hale. It was first set forth in his address as vice-president of the anthropological section at the Buffalo meeting of the American Association in 1886, and more fully expounded in a paper read recently before the Canadian Institute at Toronto.

The foundation of this theory is the frequently observed fact that children occasionally form a language of their own, apparently totally different from that of their parents. Hale has carefully compiled observations on this subject, and gives in both his papers very interesting and remarkable instances of such languages. He assumes that in a favorable climate a group of children may have become separated from grown-up persons, and thus developed a language of their own. He assumes that the process of forming dialects is entirely and fundamentally distinct from that of forming linguistic stocks. He concludes that children's languages of the type mentioned above are formed at one stroke, complete in all their grammatical elements. A few of the examples mentioned go far to show that this view is correct; but so far we miss the proof that these languages are really fundamentally distinct from that of the parents, as no philologist has ever studied one of them thoroughly. Hale explains the similarity of groups of linguistic stocks in regard to their structure by assuming a potential faculty in the child to develop on a certain line. Such a faculty, in as complex a phenomenon as speech is, seems to us very improbable, and we are more inclined to see in such structural similarities a genetic connection.

Undoubtedly Hale has pointed out for the first time one of the most potent factors in the evolution of language, and the problem he propounds is so important that it ought to be taken up energetically.

As in every community child-language dies before being far advanced, it is self-evident that Hale's theory holds good only in such countries where a complete isolation of a few individuals, and complete interruption of their intercourse with the tribe from which they separated, are possible. Such can only have been the case where vast tracts of land were uninhabited; and, as this is no longer the case, the non-occurrence of such phenomena in historic times cannot be considered proof against the theory. One phenomenon of great importance we will mention in this place, as it is greatly in favor of Hale's theory, but unfortunately we do not know whether the authority is a good one. The children of a tribe of hunters in South Africa are said to speak a language of their own, which they do not give up until they take part in the expeditions of their parents. If this really means that a language has developed, spoken by all the children of the tribe, it would be an important step on the line indicated by Hale.

If this theory is correct, the difference between the development of dialects and linguistic stocks cannot be as fundamental as Hale assumes. Wherever occasion is given for a complete isolation of a few children, occasion also arises for an isolation of a few adults and many children, forming one household. In this case the language of the children may gain a dominating influence over that of the adults. The result of such an event would be a language similar in structure to the original language, while the vocabularies would be distinct in important features. It seems probable that children's speech may have had a great influence in the origin of dialects of certain linguistic stocks in which numerous words occur that have undoubtedly originated independently in the respective dialects. The probability of such an event has been recognized by Hale, who points out that his theory explains the fact that certain words are common to a great number of stocks, although they may differ in all other respects. He thinks that such words were remembered by the children, and retained in their new language. The character of the new language will also depend entirely upon the stage of development of the language of the respective children. We all know that the common baby-talk has to a certain extent the same, although simplified, structure as the mother-tongue, while its vocabulary includes many independent words. Undoubtedly there exist numerous intermediate stages between such baby-talk and a child-language of absolutely independent character — if such exists. Therefore, if these languages really gave rise to new languages, we might expect to observe a gradual shading-off between dialects and stocks. It is very probable that by the process suggested by Hale numerous new elements may have developed in the language of isolated families.

We are not inclined to accept his theory as explaining the origin of stocks entirely distinct in structure until it has been proved that a child's language of such character exists. Our reason for this opinion is, that a child's language cannot originate until the child has learned from its parents, and from other people with whom it comes in contact, that speech is a means of communication; that is, until it has apperceived the connection of certain sounds with certain other sensations. Therefore it seems probable that even an apparently independent child's language must be to a great extent influenced by the language it hears.

Therefore it appears of the greatest importance that the child's language should be studied in all its aspects. Some of the in-

stances mentioned by Hale are of the greatest interest, and we reprint one here, as it shows clearly what the subject of this study ought to be. In his second paper on this subject, Hale quotes from a letter from Von der Gabelentz the following: "My brother Albert's eldest son George, before he had learned his mother-tongue, called things by names of his own invention. In these names the constant elements were the consonants, while the vowels, according as they were deeper or higher, denoted the greatness or smallness. For instance, his term for ordinary chairs was *lakail*, apparently quite a self-made word. Now, he would call a great arm-chair *lukull*, and a little doll's chair *likill*. The root for round objects was *m-m*. He called a watch or a plate *mem*, but a large plate or a round table *mum*; the moon was likewise *mem*, but when he first saw the stars he said *mim mim mim mim*. His father, and at first every grown-up male person, was called *papa*, till he learned to distinguish between Papa and Grosspapa (*o-papa*), and henceforth called all other gentlemen *o-papa*. Now, I am a head taller than was my father. So one day, when seeing my father and me together, baby called the former *o-papa* and me *u-pupu*. One day in winter he saw his father in a large fur cloak and with his hat on. This impression he uttered with the word *pupu*, meaning a very big papa. The boy soon gave up his idioglottic endeavors, learning German before his next-born sister had reached the age of beginning speech. So *that* language could have no further grammatical development."

THE GREAT MEDICAL CONGRESS.

The First Triennial Session in Washington. — A Series of Brilliant Meetings. — Some of the Papers read. — Distinguished Guests.

THE meeting of the Congress of American Physicians and Surgeons, which took place in Washington last week, continuing three days, marked a new departure in national gatherings of American medical men. It was a convention of specialists, of men who have pursued their investigations, each in his own department, far beyond the point reached by the ordinary practising physician, even though his professional equipment be of the best. The papers that were read, therefore, presented the results of the most advanced scientific researches in the several departments, and the organization of the congress is such as to insure in the future the maintenance of this high scientific standard. All opportunity for scheming medical politicians to gain prominence or office is carefully guarded against, and the only chance that any physician has to gain distinction through membership of the congress is by presenting papers of such high order of excellence as to command the attention and secure the approval of the learned members of the medical profession to whom, as to the most competent critics, he submits his work.

Perhaps the best idea of the scope and objects of the congress may be gathered from the address with which Dr. Pepper of Philadelphia, chairman of the executive committee, opened the first session. He said, —

"On behalf of the executive committee, I have the honor to announce to you, the members of the various special associations composing the Congress of American Physicians and Surgeons, the manner in which we have discharged the responsible duty intrusted to us. The present meeting is the result of prolonged deliberations. The development of one special society after another showed the irresistible tendency of the recent progress of medical science. The deep interest which attaches to the meetings of these separate bodies suggested naturally the thought of a conjoint meeting, which would bring together the active workers in allied fields. This thought began to take definite shape as much as four years ago, before the attention of the medical profession became occupied with the preparations for the meeting of the International Medical Congress which occurred in this city last year. But all action was deferred, in order that there should not be even the semblance of interference with that important meeting. The delay has not been injurious. It has rendered more than ever conspicuous the actual need of an organization to secure the re-union, at stated intervals, of the more active teachers and writers and workers in the leading branches of medical science. Such re-unions must be at a locality to which it will be possible to draw such men from all quarters.

"In order to produce the best scientific results, it is essential that the members in attendance shall be reasonably limited, and that as far as possible the same men shall attend successive meetings. A continuity of intellectual life and activity is thus secured, which increases greatly the benefits derived from these meetings. A large proportion of those interested in the development of such an organization are, as I am myself, warmly attached to the American Medical Association, and determined to exert their influence to maintain and promote the success of this great national organization. All are no less warmly interested in the prosperity of the various special societies to which they severally belong. Your executive committee found little difficulty, however, in deciding upon a plan which would avoid even the least interference with the American Medical Association, while at the same time it avoided any encroachment upon the independence and autonomy of the special societies. It is unnecessary to dwell upon the special points which have been embodied in the by-laws which will be immediately submitted to you.

"Your committee ventures to hope that these provisions, which are strictly in accord with the terms of the resolutions under which they were appointed, will meet the unanimous approval of the congress. We have recommended that the sessions shall be triennial, thus leaving to each participating body two intervening independent meetings, at such time and place as may be chosen. We have jealously guarded against the admission of any parliamentary business into the work of the congress, the functions of which are designed to be absolutely and exclusively scientific. Thus, and thus only, can the sessions of this body be lifted up into and maintained in that high and cool air of learned discourse which best permits the diffusion of truth and the promotion of science. We have no less jealously guarded the independent sovereignty of each participating society. To all their full rights are preserved; to all equal privileges are accorded; upon all the burden of expense, which should always be but a light one, has been laid in equitable distribution. The successive meetings of the congress will be held in this beautiful city, which every year renders more accessible, more attractive, and more precious to every citizen of the Republic. Nor could we fail to make acknowledgment of the great material advantages we shall enjoy in these meetings here, through the liberal and enlightened policy which places freely at our disposal the admirable facilities of the medical department.

"And, lastly, your executive committee would report that in the discharge of one of the most important of our duties we have reached the conclusion that the selection of the president of each congress shall be intrusted to the executive committee then in office. Thus will the choice of the most worthy and most representative men of the whole country be insured at the hands of a truly representative body, specially selected by their various societies for their ability and judgment. The powers you are asked to confide to future executive committees are large, but they will be reposed in safe hands. Each society participating will be stimulated to continuous and lofty effort. Membership in any of these bodies will come to be regarded as more and more an honor, and in time the scientific qualifications of candidates will be more and more strictly scrutinized. Can there be any doubt, that, if the spirit which has led to the formation of this congress be maintained and cherished, this new organization will exert a powerful and beneficent influence on the future medical science? It remains, then, only to add, that, in exerting the privilege of selecting a president for this first Congress of American Physicians and Surgeons, your executive committee feel they have been guided to the choice of a man whose admirable personal character, whose high attainments, and whose illustrious services in the cause of literature, of science, and of the entire medical profession, mark him as entitled to this great honor and distinction. It gives me, therefore, the utmost gratification to present to you our president, Dr. John Shaw Billings, and to announce that the Congress of American Physicians and Surgeons is now duly organized."

Dr. Billings, on taking the gavel, in a few words expressed his appreciation of the honor which had been conferred upon him. His formal address was given on Thursday evening, and was published in last week's *Science*.

The address of welcome by Dr. S. C. Busey of Washington,

chairman of the committee of arrangements, was warm and cordial He spoke of Washington as a great scientific centre, as it is. It would probably have surprised the members of the congress if he had added, as he might have done, that there are in Washington more than nine hundred men who are engaged in scientific work. It may be remarked here that the work of the committee of arrangements from beginning to end — from the banquet on the evening before the congress met, to the magnificent reception with which it closed — is worthy of the warmest commendation.

At the first meeting of the congress, also, Dr. Pepper submitted the following rules of organization, which were adopted: —

"1. This organization shall be known as 'The Congress of American Physicians and Surgeons.'

"2. It shall be composed of national associations for the promotion of medical and allied sciences.

"3. It shall hold its sessions triennially in the city of Washington, D.C.

"4. The officers of the congress shall be a president, vice-president, a secretary, a treasurer, and an executive committee.

"5. The president shall be elected by the executive committee, of which he shall be *ex officio* a member.

"6. The presidents of the participating societies shall be *ex officio* the vice-presidents of the congress.

"7. The secretary and the treasurer shall be elected by the executive committee. They shall be *ex-officio* members of the executive committee.

"8. The executive committee shall be composed of one member from each participating society, and said members shall be elected by the various societies at the next annual meetings subsequent to the congress.

"It shall be charged with all duties pertaining to the organization of and preparation for the ensuing congress, including the election of all officers and of a committee of arrangements.

"It shall superintend the publication of the transactions of the congress.

"9. The expenses of the congress shall be divided between the participating societies in proportion to their membership.

"10. The admission of new associations to participation in the congress shall be by unanimous vote of the executive committee."

Typhoid-Fever.

The eleven medical and surgical societies from the membership of which the congress is composed held their annual meetings during the three days of the congress. A great number of papers were read, a few of which, only, it will be possible to mention here.

At the Tuesday meeting of the Association of American Physicians, Dr. W. W. Johnston of Washington presented an important paper on 'The Geographical Distribution of Typhoid-Fever in the United States.' In brief, he said: "Typhoid-fever is admitted to be a very generally distributed disease in the United States, but there is a great difference of opinion as to what constitutes typhoid-fever, — what symptoms are essential to its recognition. The difficulties lie in the fact that typhoid-fever is frequently a very mild disease, with few of the characteristic symptoms; and that sometimes the illness is so slight that its true nature is not recognized until some sudden accident, as hemorrhage from the bowels or perforation, reveals its true nature. The difficulty is increased still more by the simultaneous occurrence, in malarial districts, of forms of fever which have some of the symptoms of typhoid-fever and some of malarial-fever. The question is to determine to which category such obscure or doubtful cases belong. In the present paper the effort was made, by a study of the prevailing forms of continued fever in different portions of the country, to determine the relative value of their symptoms, and to arrive at more precise rules of diagnosis. Such a study reveals the fact that the principal forms of fever recognized are (1) true typical typhoid-fever: (2) true typical malarial (remittent or bilious) fever; (3) adynamic malarial-fever; (4) typho-malarial fever; (5) anomalous obscure forms appear as simple, continued fever, gastric-fever, autumnal-fever, etc. An analysis of the symptoms given by physicians in different parts of the country shows that great difference of opinion prevails as to the symptoms of these fevers; but such an analysis and comparison show also that true typical typhoid-fever and true remittent-fever are clearly defined; that 'adynamic remittent-fever' is a term which is used to designate a class of fevers consisting partly of remittent-fevers, and partly of typhoid-fever of a typical character. In regard to typho-malarial fever, no fixed ideas exist as to what symptoms indicate it; and so great is the confusion, and so hopeless the task of giving this disease an appropriate place, it is clear that much would be gained by abandoning the terms altogether. As regards the obscure forms mentioned, there is the tendency to class many of them under the head of mild or typical typhoid-fever. But there is a great deal yet to be learned about these forms; and much progress can be made by a close study of the micro-organisms found in the blood of these cases, and by a closer study and unbiassed appreciation of their symptoms."

Heat-Centres in Man.

In the Tuesday meeting of the American Neurological Association, the paper that probably was of most popular interest was that read by Dr. Isaac Ott of Easton, Penn., on 'Heat-Centres in Man.' He showed by cases of disease that in the brain of man are points whose function it is to preside over the temperature of the body, and to keep its heat constant. These centres were partly located upon the surface and partly at the base of the brain. He also related cases on record of a temperature as high as 128° F., and as low as 94° F. He explained how these great changes of temperature could be produced through disease of the nervous system. Cases of children were detailed whose temperature was 110° F. for a short time and recovered. Fever was stated to be mainly a disease of the nervous system, causing increased chemical changes in the tissues of the body, and thus elevating the temperature.

Searching for the Yellow-Fever Germ.

At the meeting of the Climatological society on Wednesday, Dr. G. M. Sternberg, surgeon U.S.A., read a very important paper, in which he gave a report of the result of the search for the yellow-fever germ which he has been prosecuting under the direction of the President. The title of his paper was 'Recent Investigations relating to the Etiology of Yellow-Fever.' The subject is one which, on account of the prevalence of this disease in the Southern States, is just now of absorbing interest, not only to the medical profession, but to the public generally. Dr. Sternberg said that there have been several different claimants to the honor of having discovered the yellow-fever germ, but none of these claims are well founded. He exhibited to the association cultivations of the germs of Dr. Domingos Freire of Brazil, of Dr. Carlos Finlay of Havana, and of Dr. Paul Gibier of France. The last-named physician was commissioned by the French Government to study yellow-fever, and had already been in Havana for several months, when, in May last, Dr. Sternberg arrived in that city in compliance with instructions from the President to continue the investigation commenced last year in Brazil and in Mexico.

Through the courtesy of the Spanish army-surgeons at the military hospitals in Havana, Dr. Sternberg was able to obtain as many autopsies as he required, and made a careful search of the blood in the various organs of the body with reference to the presence of germs. He did not encounter in a single case the microbe which Dr. Domingos Freire has described, and with which he professes to practise protective inoculations. He has, however, encountered this micrococcus in cultures made from the surface of the body, and believes its presence in Dr. Freire's blood-cultures from the finger to have been quite accidental and without special significance.

Having proved by his microscopical researches and culture experiments that there is no specific germ in the blood of yellow-fever patients, Dr. Sternberg turned his attention to the alimentary canal, thinking it not improbable that the specific germ of the disease might be located there, as it is the case in cholera. As was to have been expected, he encountered a variety of micro-organisms in this situation, some of which were apparently undescribed species, and therefore possible yellow-fever germs. Among these is the bacillus of Dr. Paul Gibier, which was found in three out of ten cases. According to Dr. Sternberg, Dr. Gibier has not as yet given any satisfactory proof that this is the veritable yellow-fever germ, and further researches are required in order to determine the important questions relating to the cause and prevention of this disease. Dr. Sternberg has himself discovered several new micro-

organisms, and it is possible that one or the other of these is the deadly microbe which he has so long been in search of; but he is not at present in a position to make a definite claim with reference to any one of them. Some of these germs were exhibited to the association; and Dr. Sternberg stated that since his return from Havana he had been continuously engaged in the study of these various microbes, and that the material which he had brought with him would fully occupy his time for some months to come.

Consumption among the Indians.

At the same meeting, Dr. W. Matthews of the Army Medical Museum read a paper entitled 'Further Contributions to the Study of Consumption among the Indians.' Before a meeting of this society, held in Philadelphia two years ago, Dr. Matthews presented a paper on this subject, in which he brought forward statistical evidence to show that consumption increases among Indians under the influence of civilization, i.e., under a compulsory endeavor to accustom themselves to the food and habits of an alien and more advanced race, and that climate has very little to do with this increase. The Indian race, which is native to the climate, suffers more from consumption than the white and colored races, which have only recently appeared on the western continent. As a rule, too (to which there are some exceptions), the tribes that live in the Eastern States, and have been longest under the influence of civilization, suffer most from consumption and allied diseases. In the present paper the author brings out much additional evidence to strengthen the conclusions of his first paper, and endeavors to discover the causes of this consumptive tendency among Indians. He believes that the disease with them is usually complicated with scrofula, in short that it is scrofulous phthisis, and that in studying it we must seek for the causes of scrofula. Chief among these is improper and badly cooked food. Other causes are bad dwellings and insufficient clothing. Still it is strange that the colored population, who are often as badly housed and fed as the Indians, are more healthy. This is partly accounted for by difference of disposition, the Ethiopians being the more light-hearted race. Much of the difference, too, arises from the fact that all Ethiopians, whether rich or poor, fair or dark, are placed by statisticians under the head of 'colored;' while people of Indian descent, who live among whites, and sever their tribal relations, are classed as whites, only the poorer and less prosperous remaining on the Indian census-rolls.

Cerebral Localization.

The most brilliant meeting of the congress proper was that of Wednesday evening, when one of the most interesting subjects in medical science, cerebral localization, was discussed by several of the most distinguished specialists of the world. Dr. Charles K. Mills of Philadelphia, the professor of diseases of the mind and nervous system in the Philadelphia Polyclinic and College for Graduates in Medicine, opened the discussion, the topic being 'Cerebral Localization in its Practical Relations.' He was followed by Dr. Roswell Park, professor of surgery in the Buffalo Medical College. Both of these gentlemen read papers, which were discussed by Dr. David Ferrier and Mr. Victor Horsley of London, England, Dr. W. W. Keen of Philadelphia, and Dr. Robert F. Weir of New York City. Diagrams were displayed on the wall, and by their aid the various speakers pointed out the brain-centres. Dr. Ferrier, one of the original discoverers of brain-centres, claimed that they were distinct areas, while Mr. Horsley was of the opinion that they overlapped. Dr. Mills's paper was an exhaustive one, describing the results of the latest modern discoveries. Dr. Park covered about the same ground, and his paper was regarded as a masterly exposition of the subject.

Distinguished Guests.

The congress was notable for the distinguished guests of several of the constituent societies who were present and participated. Among these guests, Dr. Frederick von Esmarch of Kiel, Germany, was probably the most distinguished. He was accompanied by his wife and son, the former being Princess Caroline Christian Augusta Emily Henrietta Elizabeth of Schleswig-Holstein-Souderburg-Augustenburg. She is aunt of the Empress of Germany. Dr. von Esmarch is director of the surgical clinic in Kiel. During the Franco-Prussian war he was a surgeon on the staff of the Emperor, and is recognized as one of the leading surgeons of the world. He is a voluminous writer, and nearly all of his works relate to the antiseptic treatment. He has endeavored to ameliorate the horrors of war by the introduction of improved sanitary measures in the treatment of the wounded, and also by suggestions in case of sudden accident. He first suggested the method of artificial bloodless operations, which was generally adopted. He has received honors abroad and at home, and wears decorations of the highest order.

Among the other foreign guests were Dr. David Ferner of London, England, one of the leading medical writers of the day, joint editor of *Guy's Forensic Medicine*, professor in King's College, and physician in King's College Hospital; Dr. Victor Alexander Haden Norsley of University College and Brown Institute, England; Dr. W. M. Graily Hewitt of London, England, a distinguished author and professor; Dr. Lawson Tait of Birmingham, England, president of the Birmingham Philosophical Society, and author of 'Diseases of Women,' a recognized text-book for students and practitioners; Sir Spencer Wells of London, England, surgeon to the Queen's household, and an extensive writer on medical subjects; Sir Andrew Clark, also of London, president of the London Medical Society; Sir William MacCormac, author of 'Notes and Recollections of an Ambulance Surgeon,' which has been translated into several continental languages; Dr. William O. Priestly of London, a voluminous contributor to medical literature; Dr. William Ord of London, a physician and lecturer of high rank; Dr. Thomas Bryant of London, lecturer on surgery in Guy's Hospital; Dr. Reginald Harrison of Liverpool, England; and Dr. Arthur E. Durham of London, England. Several of these distinguished guests, by invitation, read papers or joined in the discussions.

In every respect the congress was successful. It contributed to the advancement of the highest medical science, and has furnished a stimulus for future work.

MAJOR POWELL'S REPORT.

Operations of the National Survey. — Yellowstone Park. — Atlantic Coast Work. — Archæan Geology. — Glacial Geology. — Appalachian Division; Classification of Soils.

Operations of the National Survey during the Year ending June 30, 1888.

DIRECTOR POWELL of the United States Geological Survey has completed his report for the last fiscal year, and Sept. 6 transmitted it to the secretary of the interior. There will probably be several months' delay in the publication of it, owing to the lack of facilities in the Government Printing-Office; but the Washington correspondent of *Science* has been permitted to make the following full extracts and summary from the manuscript copy. This is the first publication of this report.

In the topographic department an area of 52,062 square miles was surveyed during the year. In regard to the scale on which the topographic maps are made, the director says, "In the earlier work of the Geological Survey it was contemplated that a large part of the general topographic map should be projected upon a scale of four miles to the inch. . . . The last two years, however, have brought great improvements in the methods of work, in the instruments and appliances, and, above all, in the skill and efficiency gained by the topographers through experience and zealous emulation. The cost of the work per unit of area upon any given scale has greatly diminished, the quality and accuracy of the work has been much improved, and the rapidity with which a given grade of work may be accomplished has increased. At the same time the demand for maps of greater detail, and upon a larger scale than four miles to the inch, has been rapidly growing, not merely for scientific purposes, but far more for economic purposes.

"The general utility of a map two miles to the inch is, for all purposes, many times greater than that of a map four miles to the inch; and a further increase of utility follows from increasing the scale to one mile to the inch. . . . It has therefore become practically imperative to enlarge the scales in some regions, while the original four-mile scale is still adhered to in the regions of high mountains and arid plains and plateaus. The increased cost which (other things being equal) necessarily attends the production of larger

scale and more accurate and elaborate maps has in great measure been offset by more economic and more efficient service, resulting from constantly growing experience and skill in field and office work."

Yellowstone Park.

"Under the charge of Dr. Arnold Hague," says Director Powell, after treating of several other topics, "the survey of the National Park has made much progress. A topographic map of the Mammoth Hot Springs basin has been made by Mr. Anton Karl of the topographic corps, and maps of the other geyser basins have been completed. Dr. Hague's geologic work has been prosecuted in the eastern portion of the park, in the comparatively little-known area around the northern part of the Wind River Range and the Absaroka Range, which constitute some of the grandest features of the region. His inquiries have thrown much light on the geologic history of the features of the park, and of the volcanic processes which produced such wonderful results. Many instructive studies have been made of the action of the geysers and the hot-springs, and of the mineral deposits to which they have given rise.

"Dr. Hague's attention has been forcibly drawn to the importance of this reservation as a storage-area for the head waters of some of the largest upper tributaries of the Missouri, and also of the Snake River. Yellowstone Lake is the largest natural reservoir of the Rocky Mountain region, and may be made an important factor in the prosperity of future populations of the country adjoining the lower courses of the Yellowstone, who will be dependent upon its waters for irrigation. Dr. Hague has devoted much time to the investigation of this important subject, and has obtained information which cannot fail to be of great value in the future deliberations of Congress upon questions relating to its policy towards the public lands upon this broad watershed of the continent."

Atlantic Coast Work.

"The examination of swamps and marsh-lands," continues Major Powell, "has been continued during the past year under the charge of Prof. N. S. Shaler. The large area of such lands along the Atlantic coast south of New York, and their situation upon the coast-line, make them especially important, and even a subject of solicitude in relation to the future development of the country. Deleterious to health in their natural condition, an obstacle in the way of approach to the sea, repellent to the settler, to agriculture, and to manufacturers, they yet hold out the hope of highly productive utilization through the judicious application of capital. Wherever they are susceptible of effective drainage, they are generally among the most valuable lands for agricultural purposes, and their unhealthful condition is ameliorated, or even wholly remedied. There are over 100,000 square miles of such land in the United States, a large proportion of which, by good engineering, can be rendered highly productive. Much of it abounds in peat or iron ores, and in South Carolina and Georgia it contains the products of phosphates, which are collected and treated in chemical works in steadily increasing quantities. The swamps and overflowed lands of the interior present analogous conditions. Professor Shaler has visited the Everglade region of southern Florida, along the coast, to ascertain the general facts with reference to the possibility of drainage, and with highly encouraging results. He has investigated such evidences as were accessible, bearing upon the origin of the topographic features of the southern part of the peninsula, and especially those which are indicative of elevation or subsidence of the land in recent geologic time. He has also made a preliminary study of the phosphate deposits of South Carolina, and the results have been put in form to be published as a bulletin of the Survey.

"Progress has been made in mapping the swamp districts of Massachusetts, and Professor Shaler has completed the mapping of those occurring in the vicinity of Abington and Newburyport. A large amount of special geologic work, bearing upon particular questions now under investigation, has also been done under Professor Shaler."

Archæan Geology.

"In many parts of the United States extensive exposures of very ancient strata occur, embracing in some cases formations which are older than the oldest fossiliferous rocks of assignable age. In other cases there are formations of the same ages as some of the fossiliferous beds, but in a condition which indicates that they have undergone great changes since their deposition. Not only have their component beds been tilted, bent, folded, dislocated, and distorted to extreme degrees, but their mineralogic contents and their textures have been more or less altered. One effect of this metamorphism has been the obliteration of any fossils they may have contained originally, upon which the geologist mainly relies in determining the ages and relations of strata. The confusion into which these masses have been thrown by the forces which have fractured and distorted them has increased the difficulty.

"The present state of knowledge relating to the origin, relative ages, and former condition of these strata, to the nature of the processes which have wrought these profound changes in their constitution, and to their relation with each other, is very unsatisfactory, although no rocks have been more earnestly studied. While the knowledge which has been gained is vast in amount, and highly useful in its way, it has not been of such a character that it could be grouped and generalized into broad inductions, and it has thrown comparatively little light upon the most important questions.

"There are large areas in the United States where these rocks are exposed. The most extensive are in the New England States, the southern Appalachians, the vicinity of Lake Superior, and many parts of the great mountain region of the West, and especially the ranges upon and near the Pacific coast. It is deemed of importance to the interest of geologic science in general — both of systematic and economic geology — to take up this subject and prosecute investigations of the older crystalline rocks with vigor. The two fields which are regarded as offering the best opportunities and prospects for these investigations are the New England States and the Lake Superior region. In the former field, Prof. R. Pumpelly has been diligently at work with several assistants. Convinced that the Green Mountains of Vermont and Massachusetts are more likely to yield desired results and to clear up the broader questions relating to the geology of New England, he has divided the country into zones across those mountains, and is prosecuting the investigation of their structure in great detail. He has already ascertained the components of the Green Mountain series of strata, has gained considerable knowledge of their lithology and relations, and has made much progress towards unravelling their complicated structure, and learning the processes by which their metamorphism has been effected."

After a brief account of the investigation of corresponding horizons in the Lake Superior region, closing the notice with a deserved tribute to the late Prof. Roland D. Irving, who was in charge of this work, and who died in May last, Major Powell passes to a brief review of the work done during last year in the glacial division.

Glacial Geology.

"The study of the vestiges of glaciation," says the director, "has been conducted by Prof. T. C. Chamberlin. The New England States, New York, a large part of Pennsylvania, and in general the States north of the Ohio River and east and north of the Missouri, constitute a region whose superficial deposits and soils, whose lakes and minor topographic features, have been profoundly modified, and in great part made what they now are, by the action of glaciers. This region, as well as the basins of the Great Lakes and the Canadian Provinces indefinitely northward, was doubtless during a recent geologic period sheeted over with ice in a manner which finds a counterpart in the present condition of Greenland. This conclusion — and a similar one has been reached with respect to certain portions of Europe — rests upon a vast mass of circumstantial evidence so clear and convincing, when fully understood, that it may be regarded as one of the most wonderful and pleasing examples of inductive reasoning, and one of the best established that the whole realm of modern science affords. Professor Chamberlin's work has been the investigation of the extent of this former field of ice and its boundaries, the nature of its action in shaping surface features, the chief incidents of its history, and the geologic and climatic changes which were associated with it, whether as causes or effects.

"Near the close of the glacial period there existed, in the region now embraced in the valley of the Red River of the North and that of the Saskatchewan, a great lake, to which the name of Lake Ag-

assiz has been given. Its former existence was first clearly shown. and its approximate limits roughly defined, by the late Gen. G. K, Warren of the Engineers. A considerable arm or bay of this lake extended up the Red River valley into Dakota and Minnesota. Its ancient beaches are still easily discernible, and its bottom received the deposits of sediment ground from the rocks by the great continental glacier upon whose western margin the lake was situated. These deposits constitute those soils of the Red River valley which have lately become so famous for their fertility. In co-operation with the Canadian Geological Survey, in whose territory the greater part of Lake Agassiz was situated, Professor Chamberlin's assistant, Mr. Warren Upham, has made a study of the portions of this lake-basin and of its branches which lie within the United States. This work has already occupied Mr. Upham during several seasons, and is still in progress, and has brought to light many instructive and important facts. Examinations have also been made of the glacial deposits in the Coteau du Plateau du Missouri of Dakota, by Prof. J. E. Todd; in northern Illinois and adjacent parts of Indiana and Michigan by Mr. Frank Leverett; in Wisconsin by Mr. I. M. Buell; in Indiana by Prof. L. C. Wooster; and in Maine by Prof. George H. Stone. Large and important additions have thus been made to our knowledge of the distribution and action of the ancient ice-sheet, and of the history of the continent during the glacial period."

Appalachian Division. — Classification of Soils.

Probably the most important section of Major Powell's report is that in which he announces a new, scientific, and systematic classification of soils. He has long been engaged in the study of this subject, and has given his classification to some specialists and institutions, but this is the first publication of it. It will attract wide attention on account both of its scientific and its economic importance.

After briefly stating the progress of the geologic work of the year in the Appalachian division, under the direction of Mr. G. K. Gilbert, Major Powell proceeds: "The soils of the region are derived from the rocks. In part they are constituted by disintegrated rock not otherwise disturbed, and holding its original position; but in part they also result from the transportation and sorting of disintegrated rock by streams, waves, glaciers. The complete mapping of the geologic features thus shows the distribution of the soils, and it has been determined to separate the data concerning soils, and prepare a soil-map to accompany each geologic map. The field-parties gather data for both at the same time.

"In planning this work it has been found necessary to adopt a working classification of soils. The following is an exhibit of the scheme. It is held only as a tentative classification, to be enlarged, modified, or reconstructed, as the facts developed in the progress of investigation may demand.

"*Endogenous soils* are those derived from the country rocks, and remaining in place.

"*Exogenous soils* are those derived from other sources than the country rocks proper to the district where the several soils are situated.

"*Endogenous soils* are classed in conformity with the rocks from which they are derived, as,

"I. Sandstone soils.
"II. Limestone soils.
"III. Granite soils, etc.

"*Exogenous soils* are classed as,

"I. Alluvial soils; i.e., those formed from deposits on flood-plains made by running waters.
"II. Lacustrine soils; i.e., those formed from deposits in lakes.
"III. Marine soils; i.e., those formed from deposits made by the action of waves and currents along the shores of the sea.
"IV. Drift soils; i.e., those formed from deposits made by glacial agencies.
"V. Swamp soils; i.e., those formed from deposits made in fresh-water swamps.
"VI. Marsh soils; i.e., those formed from deposits made in marine marshes.
"VII. Dune soils; i.e., those formed from deposits of drifted sands.
"VIII. Volcanic soils; i.e., those formed from volcanic ashes.
"IX. Overplacement soils; i.e., those formed from rocks that have been transported by gravity, as talus soils, land-slide soils; also those formed of alluvial cone rocks.

"Under the several species recognized above, important varieties are found.

"The classification thus briefly set forth seems to be natural, simple, and easily applied to the facts presented in field-study."

Passing over a section on correlation of formations, under the review of the work in the division of volcanic geology, Major Powell says, "For nearly two years Captain Dutton has been occupied in the investigation of the Charleston earthquake, and in preparing a monographic report upon it. In many respects the best observed earthquake that has ever occurred, and perhaps the most carefully studied, it has yielded results which undoubtedly add to our knowledge of such phenomena. But Captain Dutton, after two years of laborious investigation, is still of the opinion that the result adds but little to our knowledge of the ultimate causes which produce such catastrophes."

The remainder of Major Powell's report includes a review of geological work in connection with the Potomac formation and in Montana, and of the extensive paleontological investigations that have been carried on. A review is also given of the work done in the division of chemistry and physics, and the report closes with brief notices of the illustrations division and of the library.

HEALTH MATTERS.

Food-Preservatives.

In a pamphlet on the effects of food-preservatives on digestive agents, by Henry Leffman, M.D., and William Beam, M.A., the authors say that the use of antiseptics in perishable articles of food has become quite general in recent years, and has been to a certain extent the subject of legislation. Salicylic acid has been probably the most used; and while the sanitary authorities in different countries have, as a rule, opposed its use, there has been no positive evidence of its injurious action, even when continued for some time. Lehmann published in Pettenkofer's *Archives of Hygiene* several instances in which healthy male adults had taken for many days considerable doses of this acid without apparent injury. While there may be a legitimate field for the use of these agents in articles of food of a highly perishable character, and especially where the addition is made known, there can be no question that their indiscriminate use is dangerous. Independently, however, of any directly injurious action, it is important to inquire how far they may interfere with the nutritive or medicinal value of any articles with which they may be associated. The matter has been brought prominently to the notice of these chemists, in consequence of some analyses made by them in which the free use of salicylic acid in beers and malt extracts was detected. Similar results in regard to beers were found by various State boards of health and by the Department of Agriculture of the United States Government. It becomes important to inquire how far the presence of the substances may interfere with the diastasic action ascribed to preparations of malt. Of eleven samples tested, including all the extracts widely known in this market, only four had any appreciable effect on starch, and but one of these was strikingly efficient. They have undertaken to determine what retarding effect such preservatives may possess.

The antiseptics selected were salicylic acid, boric acid, sodium acid sulphite, saccharine, beta-naphthol, and alcohol. The sample of beta-naphthol was of the form now sold under the name 'hydro-naphthol.'

From the experiments it will be seen that salicylic acid prevents the conversion of starch into sugar under the influence of either diastase or pancreatic extract, but does not very seriously interfere with peptic or pancreatic digestion of albumen. Saccharine holds about the same relation as salicylic acid. Sodium acid sulphite and boric acid are practically without retarding effect. Beta-naphthol interferes decidedly with the formation of sugar by diastase

but not with action of pancreatic extract on starch. Peptic and pancreatic digestions of albuminoids were almost prevented by this agent.

It is obvious from these experiments that the indiscriminate use of these agents in the preservation of food is to be regarded as objectionable and a proper subject of sanitary supervision. Their use is scarcely allowable under any circumstances, and certainly only when the nature of the preservative, and the amount, are distinctly stated. These remarks apply more particularly to salicylic acid, saccharine, and beta-naphthol; but the use of boric acid and sodium acid sulphite may be brought also under the same restrictions, because their actions on the animal functions are not yet thoroughly investigated.

CONTAGIOUSNESS OF LEPROSY. — The contagiousness of leprosy still continues to be a mooted question. Dr. Rake, superintendent of the Trinidad Leper Hospital, has made a report to the British Medical Association which embodies the results of his experiments in the cultivation of the germ of leprosy, the *bacillus lepræ*, which have been under way for the past four years. He says that (1) at a tropical temperature and on the ordinary nutrient media he has failed to grow the *bacillus lepræ*; (2) in all animals yet examined he has failed to find any local growth or general dissemination of the bacillus after inoculation, whether beneath the skin, in the abdominal cavity, or in the anterior chamber; feeding with leprous tissues has also given negative results; (3) he has found no growth of the *bacillus lepræ* when placed in putrid fluids or buried in the earth. He further says that an inquiry of this kind is practically endless, so varied are the conditions of temperature, time, nutrient media, living animal tissues, or putrescent substance, and so many are the observations necessary to avoid or lessen the risk of errors of experiment.

FATAL SEASICKNESS. — It is not often that seasickness proves fatal; and yet that it may do so under aggravated circumstances, can easily be imagined. Such an instance recently occurred on the steamer 'Dunara Castle,' on the trip from Tiree to the Clyde. The patient was a girl, aged eight years, in whom the seasickness terminated in a convulsion, which proved fatal.

MILK. — Dr. S. Henry Dessau, in a letter to the *New York Medical Record*, recommends the use of fresh condensed milk as a substitute for mother's milk. His objections to the use of cow's milk as supplied by the milk-dealers are, that during the summer months it is impossible to obtain it fresh and unadulterated in large cities, unless at a cost beyond the reach of the masses. All of the milk that is delivered in the market of New York is at least from twelve to twenty-four hours old, and has undergone rough transportation of from fifteen to thirty miles in not strictly clean vessels. The cans used in bringing the milk to the city are not cleansed until returned to their owner. By the time that the milk has reached the poorer classes, it has commonly undergone more or less adulteration, often in spite of the closest watching by the health authorities. In the course of its consumption by the average infant, it is still further liable to lactic-acid fermentation, and, even though boiled, it is not unlikely to become scorched or made otherwise unwholesome for the infant. Perhaps the most important objection to cow's milk, notwithstanding the fact that it is regarded as the nearest approach to mother's milk, is the difficult digestion of the caseine by the delicate infant whose stomach has been damaged by an attack of summer diarrhœa. This has necessitated the invention of numerous means and measures for overcoming the obstacle, the most common of which is the addition of some farinaceous substance. Such practice for an infant, previous to the eruption of its teeth, is contrary to the provisions of nature, and, though occasionally successful, cannot be defended as a general usage upon physiological principles. Dr. Dessau thinks it impossible to adulterate condensed milk, and that the caseine of condensed milk is so altered in the condensing process as to be very easily digested. He even prefers it to milk sterilized by Soxhlet's method.

DEATH BY DROWNING. — Dr. Paul Loye, according to the *Lancet*, has published some observations made by him, bearing on the phenomena which precede death by sudden immersion. The first stage of deep inspirations lasts about ten seconds, followed by a re-action caused by the resistance to the entrance of water into the bronchioles. This lasts for a minute, and is succeeded by arrest of respiration and loss of consciousness. Finally the scene closes with four or five respiratory efforts — the last. Immersion causes an immediate rise in the blood-pressure, with slowing of the heart-beats. The action of the heart remains slow but strong till death ensues. The pressure gradually lessens, but rises just before death, to fall to zero immediately afterward. The heart sometimes continues to beat feebly for about twenty minutes. The result is the same in animals which have been tracheotomized: the period of respiratory resistance is therefore due to the respiratory muscles, and not to spasm of the glottis.

INHERITED DEFICIENCY OF A TOOTH. — Dr. Cryer says, in the *Philadelphia Medical Times*, that he has, among his patients, members of the same family, representing five generations, each lacking the left lower lateral incisor tooth. An interesting feature of this remarkable instance of heredity is that one of the members of the same family has a supernumerary lower incisor.

WHOOPING-COUGH. — The value of Mobin's treatment of whooping-cough by sulphurous acid is receiving strong confirmation from many sources. Dr. Manly, in the *Practitioner*, expresses the opinion, that, if it was carried out in every case, at the end of six months the disease would be unknown. The method used by him is as follows: the patient is in the morning put into clean clothes and removed elsewhere. All his clothes and toys, etc., are brought into the bedroom, and sulphur is burnt upon a few live-coals in the middle of the room. The fire is allowed to remain in the room for five hours, and then the windows and doors are thrown open. The child sleeps in the room the same evening. About twenty-five grams (a little under an ounce) of sulphur to every cubic metre may be burnt: this is equivalent to rather more than ten grains per cubic foot. The room is fumigated in a like manner during the night; the patient practically living in an atmosphere of diluted sulphurous-acid gas for some days, while in several cases the process is repeated at the end of a week.

THE POWER OF THE IMAGINATION. — We learn from the *New Orleans Picayune* that Dr. Durand, wishing to test the practical effect of mind-disease, gave a hundred patients a dose of sweetened water. Fifteen minutes after, entering apparently in great excitement, he announced that he had by mistake given a powerful emetic, and preparations must be made accordingly. Eighty out of the hundred patients became thoroughly ill, and exhibited the usual result of an emetic: twenty were unaffected. The curious part of it is, that, with very few exceptions, the eighty 'emeticized' subjects were men, while the strong-minded few, who were not to be caught with chaff, were women.

MENTAL SCIENCE.

The Recognition of Sense-Impressions.

WE inherit from so ancient a philosopher as Aristotle the recognition of the process of the association of ideas, as well as of the laws by which it acts. He distinguished association by similarity, by contrast, by simultaneity, and by successiveness. The contrast that binds together is due to an underlying similarity, and the latter term may stand for both processes. So, again, the last pair may be included under association by adjacency. In the hope of deciding which of these two general processes is the more real and generic, or whether, perhaps, the two apply to two different spheres of perceptions, Dr. Alfred Lehmann (*Philosophische Studien*, v. 1) devised a series of experiments, which, aside from their bearing upon this theoretical problem, present many points of interest.

The association of ideas is seen at work in the process of recalling, of recognizing as familiar, former impressions. We may speak of a simple recognition in which the mere identity of the present recollection with the mental impression formerly registered is the point; or of a recognition with details in which the time, place, outward circumstances, are also recalled with the remembrance of the impression, say, that of meeting a friend. To this must be added the recognition by means of these details, they serving as

the marks by which the impression is identified. Dr. Lehmann attempted to bring the problem to a simple issue by a study of the power of recognizing various shades of gray produced by the rotation of a disk partly white and partly black. Two such rotating disks were used, either of which could be disclosed without the other. First a 'normal' disk was shown; after an interval, either a darker or a lighter disk was shown; and the subject was to decide whether the second disk was or was not the same as the first. With this judgment, the direction of the difference, whether lighter or darker, is always noticed. In the first series, the normal disk was composed of equal parts of black and white; the lighter disk (only two disks were used) varied in the number of degrees of white it contained as in the table; the interval between the appearance of the two disks was thirty seconds, and the average number of correct answers in a set of thirty judgments for each of two observers was as follows: —

Degrees of white in disk	240	225	215	200	192	188
Observer B	29	30	27	29	17	18
Observer L	27	27	24	20	19	17

We see at once that the power of recognizing the identity of the disks decreases as the difference in shading between the normal and the light disk diminishes; fifteen answers of each thirty being right by the action of chance. The difference between the normal disk (180 degrees) and the disk of 188 degrees white is hardly recognized at all.

If we next complicate the matter by introducing a darker disk that shall always contain as much more black than the normal as the lighter contains more white, the power of recognizing the normal disk when it appears, though still the same act, is made more difficult, as the following table, based on a series of experiments precisely similar to those just cited, indicates: —

Degrees of white in dark disk	120	135	145	160	168	172
Degrees of white in light disk	240	225	215	200	192	188
Observer B	30	30	23	23	18	10
Observer L	23	23	22	20	14	11

Here mere guess-work would make ten answers in thirty correct. The proportion of correct answers is smaller than in the former case, markedly so when the disks approach one another in shade. An increase in the number of possible impressions out of which we are to select a particular one increases the difficulty of the act.

Again: the interval between the viewing of the two disks acts in a similar way. When but two disks were used, always differing by 12 degrees in the amount of white they contained (and the normal disk varying from 172 to 176 degrees of white), the average number of right answers per set of thirty, with the interval varying from five to a hundred and twenty seconds, was as follows: —

Interval in seconds	5	15	30	60	120
Observer B	30	26	25	19	17
Observer L	21	20	21	19	17

In explanation of the individual differences, we recall that it has been clearly shown that our memories are not equally retentive for all kinds of impressions, but that here personal inclination and talent find free play. Observer B is a student of art, with an interest for such color-distinctions, and thus naturally surpasses his companion. On the other hand, the effect of practice, tested by comparing the first half of the experiments with the last, is equally evident in both observers. It is to be noted, too, that after about thirty seconds the memory-images have been about equally obscured in both observers, B then making as many errors as L.

Dr. Lehmann holds, that, if we recognize color-shades by similarity, we should (when three disks are employed) less often fail to recognize the normal than the other disks, because we see it oftener than either of the others, it being shown every time. On the other hand, the adjacency hypothesis would not expect such a difference if the original shade was clearly held in memory. If the remembrance is indistinct, the extremes, the lighter and darker disks, would be less apt to be wrongly identified than the normal disk. The results speak in favor of the latter view. B, with a clear memory, made 107 confusions, in 55 of which he miscalled the normal disk, and in 52 of which he confused either the lighter or darker disk with the normal one or with one another. L, with a vague memory, made 165 confusions, 109 of which belong to the former class, and 56 to the latter.

For another experiment three scales, proceeding from black to white by five, by six, and by nine equal gradations, were prepared; and after viewing this scale, any one of the five, of the six, of the nine shades of gray was separately shown, and the attempt made to assign to it its place in the scale. With the scale of five grades (five observers and sixty observations), 96.7 per cent of all identifications were correct; with the scale of six shades (three observers, thirty-four observations), 70.6 per cent; with the scale of nine shades (four observers, fifty observations), 46 per cent. Dr. Lehmann believes that the five shades are so well identified because they have names attached to them, — black, white, dark gray, light gray, and medium gray, — and supports this by the fact that he succeeded in identifying the shades of nine-shade scale 75 per cent of all times by simply associating a number with each shade. This argues for the association through details or by adjacency in opposition to association by similarity.

If this adjacent mark is really the clew to recognition, then it ought to be a great help to have the two disks (in the first-mentioned experiments) shown side by side before shown separately for recognition. Furthermore, if the difference between the two disks is great enough to be clearly perceived, it ought to be no more likely to be overlooked than when it is much more marked. A comparison of the following with the first table supports both these inferences: —

Degrees of white in light disk	240	225	215	200	192	188
Observer B	28	29	21	23	19	25
Observer C	27	28	24	22	20	22

Furthermore, so slight an interval as from five to a hundred and twenty seconds ought not seriously to affect the clearness of this distinction. A comparison of the following with the third table bears evidence to the truth of this deduction (the normal disk contains 180, the lighter 215, degrees of white): —

Interval in seconds	15	30	60	90	120
Observer K	26	23	27	27	25
Observer L	23	27	23	28	25

To more completely show that this retention was not due to the persistence of a memory after-image, an interval of a hundred and twenty seconds was used, within which another recognition-experiment was made. It was found that this interruption did not seriously decrease the number of correct recognitions.

Individual differences ought likewise not to be so marked with this process, and a reference to the tables shows that they are slight. Practice has little effect. Four observers made correct identifications 'through details' 83.8, 85.8, 85.8 and 85.4 per cent of all cases, while two observers differed in the percentage of correct 'simple identifications' by as much as 83.5 and 67.6 per cent.

Dr. Lehmann thus concludes that the associative law that best explains the facts is the law of adjacency in opposition to the law of similarity.

THE MAGNET AND HYPNOTISM. — The claim that the magnet influences hypnotic phenomena is strongly upheld by Parisian experimenters, while others as boldly deny this influence. The effects attributed to the magnet can be explained as due to unconscious suggestion from the operators and the bystanders. Dr. Tanzi

agrees in this opinion, which is also the verdict of a commission appointed by the medical congress held at Paris. The results announced by the Paris doctors were not obtained, and often were replaced by directly opposite results. The experiments of all outside of Paris seem to be opposed to the alleged influence of the magnet on hypnotic sensations.

THE DREAMS OF THE DEAF. — In the course of an article on dreams, etc., Mr. J. M. Buckley (*Century*, July, 1888) mentions that he has at various times made inquiry as to the occurrence of sounds in the dreams of the deaf, and found no such instance when deafness set in before the fourth year of life. One correspondent mentions that deaf people dream of hearing, if they became deaf after learning to speak. The deaf are very sensitive to jars, waking up by the beating of a bass-drum, and this class of sensations is represented in their dream-life. These facts illustrate in a conclusive manner the dependence of the imaginative and constructive powers upon the sensations, as well as point to the existence of an era when this dependence is no longer necessary for the retention of dream-fancy.

ELECTRICAL SCIENCE.

Production of Light in the Future.

THE following very interesting extract from Prof. Oliver Lodge's 'Modern Views of Electricity,' that has appeared in *Nature*, is given in the *London Electrician*: —

"The conclusions at which we have arrived, that light is an electrical disturbance, and that light-waves are excited by electric oscillations, must ultimately and very shortly have a practical import.

"Our present systems of making light artificially are wasteful and ineffective. We want a certain range of oscillation, between seven thousand and four thousand billion vibrations per second (no other is useful to us, because no other has any effect on our retina); but we do not know how to produce vibrations of this rate. We can produce a definite vibration of one or two hundred or thousand per second: in other words, we can excite a pure tone of definite pitch, and we can command any desired range of such tones continuously by means of bellows and a key-board. We can also (though the fact is less well known) excite momentarily definite ethereal vibrations of some millions per second, but we do not at present seem to know how to maintain this rate quite continuously. To get much faster rates of vibration than this, we have to fall back upon atoms. We know how to make atoms vibrate: it is done by what we call 'heating' the substance; and if we could deal with individual atoms, unhampered by others, it is possible that we might get a pure and simple mode of vibration from them. It is possible, but unlikely; for atoms, even when isolated, have a multitude of modes of vibration special to themselves, of which only a few are of practical use to us, and we do not know how to excite some without also the others. However, we do not at present deal with individual atoms: we treat them crowded together in a compact mass, so that their modes of vibration are really infinite.

"We take a lump of matter, say a carbon filament or a piece of quicklime, and by raising its temperature we impress upon its atoms higher and higher modes of vibration, not transmuting the lower into the higher, but superimposing the higher upon the lower, until at length we get such rates of vibration as our retina is constructed for, and we are satisfied. We want a small range of rapid vibrations, and we know no better than to make the whole series leading up to them. It is as though, in order to sound some little shrill octave of pipes in an organ, we were obliged to depress every key and every pedal, and to blow a young hurricane.

"I have purposely selected as examples the more perfect methods of obtaining artificial light, wherein the waste radiation is only useless, and not noxious. But the old-fashioned plan was cruder even than this: it consisted simply in setting something burning, whereby not only the fuel, but the air, was consumed; whereby also a most powerful radiation was produced, in the waste waves of which we were content to sit stewing, for the sake of the minute, almost infinitesimal fraction of it which enabled us to see.

"Every one knows now, however, that combustion is not a pleasant or healthy mode of obtaining light; but everybody does not realize that neither is incandescence a satisfactory and unwasteful method, which is likely to be practised for more than a few decades, or perhaps a century.

"Look at the furnaces and boilers of a great steam-engine driving a group of dynamos, and estimate the energy expended; and then look at the incandescent filaments of the lamps excited by them, and estimate how much of their radiated energy is of real service to the eye. It will be as the energy of a pitch pipe to an entire orchestra.

"It is not too much to say that a boy turning a handle could, if his energy were properly directed, produce as much real light as is produced by all this mass of mechanism and consumption of material.

"There might, perhaps, be something contrary to the laws of nature in thus hoping to get and utilize some specific kind of radiation without the rest; but Lord Rayleigh has shown, in a short communication to the British Association at York, that it is not so, and therefore we have a right to try to do it.

"We do not yet know how it is true, but it is one of the things we have got to learn.

"Any one looking at a common glow-worm must be struck with the fact that not by ordinary combustion, nor yet on the steam-engine and dynamo principle, is that easy light produced. Very little waste radiation is there from phosphorescent things in general. Light of the kind able to affect the retina is distinctly emitted; and for this, for even a large supply of this, a modicum of energy suffices.

"Solar radiation consists of waves of all sizes, it is true; but then solar radiation has innumerable things to do besides making things visible. The whole of the energy is useful. In artificial lighting nothing but light is desired: when heat is wanted, it is best obtained separately by combustion. And so soon as we clearly recognize that light is an electrical vibration, so soon shall we begin to beat about for some mode of exciting and maintaining an electrical vibration of any required degree of rapidity. When this has been accomplished, the problem of artificial lighting will have been solved."

ENERGY ABSORBED BY DIFFERENT LIGHTS. — Mr. Preece, in his address before the British Association, gave some figures on the energy required to produce a light of one-candle power from different illuminants.

One candle light maintained by tallow absorbs	124	Watts
" " " " " wax absorbs	91	"
" " " " " sperm absorbs	86	"
" " " " " mineral oil absorbs	80	"
" " " " " vegetable oil absorbs	57	"
" " " " " coal-gas absorbs	68	"
" " " " " cannel-gas absorbs	48	"
" " " " " electricity (glow) absorbs	3	"
" " " " " electricity (arc) absorbs	5	"

The relative amounts of heat given off may be estimated from these figures, tallow candle giving off 248 times as much heat as an arc-lamp for the same amount of illumination. As for the cost of production (Mr. Preece evidently does not include distribution), the following figures hold good in London. The cost of producing one candle light for one thousand hours is: —

	s.	d.
Sperm candles	8	6
Gas	1	3
Oil (petroleum)	0	8
Electricity (glow)	[illegible]	[illegible]
Electricity (arc)	[illegible]	1½

THE SHALLENBERGER ELECTRIC METER. — Among the numerous meters for electric currents that have been lately invented, that of Mr. Shallenberger is deserving of attention, from its ingenuity and apparent accuracy. It consists of a flat ring of soft iron mounted on an aluminium disk fixed on a spindle and surrounded by two coils, one of which is connected, either directly or through a small converter, with a circuit whose current is to be measured; the other of which is of an oval form closely surrounding the iron ring, and is short-circuited on itself. The meter is intended to measure alternating currents, and its action is briefly as follows. The alternating current in the first coil induces currents in both the

closed-circuit coil and the disk. These currents are in approximately the same phase. If the closed-circuit coil be placed at an angle with the main coil, then there will be a rotation of the disk, the rotary effort increasing until the angle between the coils is forty-five degrees. The shaft of the disk is geared to a train of counting wheels, which record the number of revolutions. On the lower part of the shaft are light air-vanes to resist the rotation. When the closed-circuit coil is set, and we have an alternating current passing through the main coil, there is a rotary effort on the disk proportional to the current; there is a resistance to the motion due to the air-vanes and the friction of the pivots. It is found that the result is a speed proportional, within narrow limits, to the current passing in the main coil. The following figures are taken from the test of a 40-ampère meter: —

Current in Ampères.	Reading of Meter.	Percentage of Error.
2.06	1.60	-
4.02	4.07	+1.2
5.00	4.95	−1.0
9 90	10.02	+1.2
15 00	15.10	+0 7
20.00	20 00	0.0
29.70	30.00	+1 0
37.40	37 00	−1.1
49 30	45.40	−7.9

In the last case the meter was overloaded. It would seem rather doubtful, however, even acknowledging the accuracy of the instrument tested, whether the friction of the moving parts will remain constant in use. Still experience must decide its practical value.

BOOK-REVIEWS.

A New English Dictionary on Historical Principles. Ed. by JAMES A. H. MURRAY. Part IV. Sections 1 and 2. Oxford, Clarendon Pr. f°. (New York, Macmillan, $3.25.)

WE noticed the first instalment of this great work in *Science* for April 25, 1884, and we are now glad to chronicle the appearance of the fourth part, completing the first volume (A and B) and beginning the second. It is superfluous to praise the work, especially after the high commendations it has everywhere received. It is generally acknowledged to be the best dictionary of any language, and when finished will be indispensable to every thorough student of English. Both its etymologies and its definitions are up to the standard of the best scholarship, while in spelling and pronunciation it is probably as satisfactory as any dictionary of English can be. The typography also is excellent; the definitions, quotations, and other items under each word being clearly distinguished by different kinds and sizes of type. The number of illustrative quotations taken from some five thousand writers of the past seven centuries is immense; and in this respect, as well as in others, the work will serve as the basis of all English dictionaries hereafter.

The number of words in the first volume is 31,254, of which 15,123 are under A, and 16,131 under B. Some of these, however, are merely variant forms or inflections of the main words, while others are special combinations explained under the main words; so that the number of main words alone is only 22,232, of which 12,183 are under A, and 10,049 under B. In a dictionary dealing with seven centuries of English literature there are necessarily many obsolete words; and yet it is found, that, "of the whole English vocabulary on record since the twelfth century (so far as A and B show), more than three-fourths is still in current use." The development of the language in recent times, however, has been great, owing chiefly to the progress of physical science and the consequent introduction of new scientific terms. Yet the dictionary does not contain by any means all the terms used in science, but only such as are used more or less as English words; the generic names in natural history, for instance, being mostly excluded.

In a dictionary based on historical principles, the subject of etymology is especially prominent; yet to ascertain the origin and derivation of some words has been found impossible, and the editor thinks that they are comparatively recent creations of the English-speaking peoples. Among such words he mentions 'bang,' 'blight,' 'blot,' 'blunder,' 'blunt,' 'bounce,' 'bunch,' and many others. One of the most valuable features of the work is the endeavor to trace, so far as possible, the derivation of the various meanings of a word from the original one. This subject is of great importance as illustrating the history of thought, and has been too much neglected by philologists hitherto. Sometimes the development of meaning is simple and easy to trace; but in some cases it is quite difficult, especially when the development takes place on divergent lines. For instance, the word 'canvas' is from the Latin *cannabis* ('hemp'), and the connection of most of its meanings with the original one can be readily traced; but, when used for the act of soliciting votes before an election, the affiliation is not apparent.

The difficulty of preparing such a work as this dictionary is immense. Its inception dates from a resolution of the English Philological Society passed in 1857, at the suggestion of the late Archbishop Trench. But before the composition of the dictionary could be begun, three and a half million quotations had to be made by some thirteen hundred readers; and the preparation of the work itself has proved much more difficult than the editors anticipated. Arrangements have been made, however, for more rapid progress hereafter; and Mr. Henry Bradley, who has been an assistant editor hitherto, is now engaged independently on the third volume, so that some of us, at least, may hope to see the completion of the work.

Facts and Opinions relating to the Deaf, from America. By ALEXANDER GRAHAM BELL. London. 8°.

THE above is the title of a pamphlet containing much valuable matter which Professor Bell collected in preparation of his report to the Royal Commission appointed by the British Government to inquire into the condition of the deaf. No one is so well fitted to be the spokesman of American activity in this direction as Professor Bell, and no one has proved himself more capable of increasing our knowledge of the deaf as a class, and the means of improving their condition. The report before us contains the answers of the superintendents of American schools for the deaf to a long circular letter drawn up by Professor Bell. Five general problems are discussed: (1) 'Visible Speech;' (2) the aural method; (3) intermarriage of deaf-mutes, and possibility of a deaf variety of the human race; (4) the self-supporting character of the education of deaf-mutes; (5) articulation-teaching.

(1) With regard to the use of 'Visible Speech,' the fact that o thirty-one institutions in which it has been introduced it has continued to be employed in only seventeen, argues against its universal applicability. The reasons for its dismissal are generally its difficulty of comprehension and tedium of learning. None the less, its hearty indorsement by so many superintendents shows that it has more in its favor than against it.

(2) The question of developing latent powers of hearing, and especially vocalization, in persons usually termed deaf but really only hard of hearing, is discussed at great length, with the general conviction that much more can be done in this direction than is usually understood. The good done in this way is not only a more or less questionable improvement of the physical hearing, but very markedly a direction of the attention to a class of sensations usually neglected, and thus increasing the accuracy of their perception. The mechanical aids to securing for the deaf a semi-hearing of their own articulations are various, and variously valued, though all seem susceptible of improvement.

(3) Doubtless the most important topic of the inquiry is that concerning the heredity of the deaf-mute class. Professor Bell, it is well known, has written a memoir urging that the tendency of the too close association of deaf-mutes with one another, as is now in vogue, is towards the formation of a deaf variety of the human race; his statistics proving that a constantly increasing proportion of the descendants of deaf-mute parents are deaf-mutes. The superintendents of schools, however, maintain that the bulk of their experience is against the truth of this thesis. Many recommend

celibacy, but urge, that, when marriage is looked forward to by the deaf, the union of two deaf persons is much surer of being attended with happiness than when one of the party is deaf and the other hearing, and that the slight and doubtful increase of a possible deaf offspring is more than outweighed by the social and personal comfort. Others draw a distinction between the intermarriages of the congenitally deaf and those who become so in mature years, urging that the probability of deaf descendants is far greater in the former case than in the latter. Many, too, regard consanguinity as a more potent factor in the production of deafness than deafness itself. Quite otherwise is the verdict given by such scientific men as Cope, Hyatt, Brewer, Newcomb, Brooks, and Bowditch. These men are unanimous in the opinion that deafness is essentially hereditary, and that the influences now in operation are similar in character to those that a breeder would furnish to bring about a variety with certain characteristics, and that these must tend towards perpetuating deafness as a constant characteristic of a certain portion of the human species. As a possible source of light in the matter, the suggestion may be offered that the heredity of deafness may vary greatly with the disease that led to it. So many cases of deafness are due to the after-effects of serious diseases, that here is a possible mode of reconciling the opposite experiences of different observers.

(4) and (5). Under these heads are given the various usages and modes of instruction in the schools of the country, with a more or less technical discussion of them.

In general, Professor Bell has succeeded in putting together much valuable matter relating to the deaf-mute class, and the presentation of this pamphlet to the royal commissioners must increase their estimation of the work of America in this field of applied science and applied philanthropy.

NOTES AND NEWS.

AMONG the publications of J. B. Lippincott Company announced as in press, we note 'An Elementary Treatise on Human Anatomy,' by Joseph Leidy; 'A Cyclopædia of Diseases of Children, and their Treatment, Medical and Surgical,' edited by J. M. Keating, M.D.; 'Life of Henry M. Stanley,' by Rev. H. W. Little; and 'Botany,' for academies and colleges, by Annie Chambers-Ketchum. —— Ginn & Co. have in press 'Voices of Children,' a theoretical and practical guide on the topic, by W. H. Leib of the National Normal Music-School. —— The October number of *Lippincott's Magazine* is a special E. P. Roe number, the first half of which is taken up with articles in one way or another commemorative of the dead novelist. —— The Hon. Hugh McCulloch will discuss in *Scribner's Magazine* for October, free ships, revenue reform, immigration, and land-monopoly; and Prof. Arthur T. Hadley of Yale will contribute an article on 'The Railroad in its Business Relations.' —— Ginn & Co. are to be the American publishers of the *Classical Review*, which is published in London, and numbers among its contributors the most eminent classical scholars of Great Britain. American scholars will be associated in the editorship.

— In a recent valuable and timely monographic paper upon the mesozoic mammals, Professor Osborn of Princeton has shown that the previously entertained views of the paucity of primitive mammalian life is not so great as has been supposed. No less than thirty-five genera are now known, including five from the trias, and one from what in all probability is correctly considered the most recent cretaceous. That all the vast gap of the cretaceous proper, so rich in vertebrate life, has not yet presented a single mammalian form, is marvellous. Scarcely less remarkable is the fact that among the known forms there is great diversity, the teeth showing six or seven wholly distinct types, "and this at a zoölogical period which we have been accustomed to consider as the dawn of mammalian life." Further, all these types, though primitive, are essentially mammalian, a single genus only showing any reptilian affinity. Very interesting, too, are the geographical and geological relationships of the genera. Among the thirteen or more North American Jurassic genera, six have their counterparts in English rocks, and the family relationships of all the rest are very close. One family, the *Plagiaulacidæ*, has its members distributed in the trias and Jurassic of both Europe and North America, the uppermost cretaceous of America, the lowest tertiary of France and America, and probably the post-tertiary of Australia, — truly a remarkable distribution, both geologically and geographically.

— In his 'Synopsis of the Families and Genera of the North American Diptera,' Dr. Williston has rendered a great service to the students of this neglected branch of entomology by bringing together in small compass so convenient and useful a series of tables. Some of these have been given before in different writings of the author, and he has compiled a part from the works of others; but in no place will the American student find so much comprised in so compact form. By means of it any student with tact can determine with considerable certainty to what genus any of his flies belong; excepting, indeed, in the case of some of the more difficult families which Dr. Williston has not attempted to include, such as the *Nematocera* and *Muscidæ*, the latter the terror of systematists. Dr. Williston has added a bibliography supplementary to that given by Osten Sacken in his useful 'Catalogue of Diptera,' bringing the needed information regarding the literature of dipterology down to date. It should prove a stimulus to the study of the *Diptera*.

LETTERS TO THE EDITOR.

Recent Changes in the Magnetic Declination in Lower California.

REFERRING to an interesting note in *Science* for June 27, in which is given a brief account of magnetic observations lately made on the coast of Lower California and vicinity by officers of the United States steamship 'Ranger,' I beg leave to add some remarks further illustrating the change or reversal in the direction of the secular motion as noticed by the observers on the late cruise of the 'Ranger,' at Rosalio Bay. While the fact is here established by direct observations, the phenomenon had already been recognized in a discussion made in the United States Coast and Geodetic Survey Office in January last, and the results were published by permission of the superintendent of the survey, at San Francisco, Cal., in the *Mining and Scientific Press* of Feb. 18, in an article on the 'Magnetic Variation on the Pacific Coast.' Not only the fact of the reversal, but the years of the reversal of the direction of the secular motion, that is, the years when the easterly declination (or so-called 'variation') ceased to increase and commenced to decrease, are there given as follows: at San Blas, Mex., in 1856; at Cape San Lucas, Lower California, in 1873; at Magdalena Bay in 1875; and on our own coast at San Diego (Cal.) in 1883, at Santa Barbara in 1880, while at Monterey the reversal is expected about 1899. The annual decrease of the declination as given in that article is as follows: —

Year.	San Blas.	San Lucas.	Magdalena Bay.	San Diego.	Santa Barbara.	Monterey.
1885	+2′.9	+1′.2	+1′.0	+0′.1	+0′ 4	−0′.9
1890	+3 .3	+1 .6	+1 .4	+0 .4	+0 .7	−0 .6

The fixation of these dates became possible through the discovery by Assistant G. Davidson of the records of magnetic declinations made A.D. 1714 off the coast of Mexico, and transmitted by him to the Coast and Geodetic Survey Office, where they were discussed by Assistant C. A. Schott.

While the results published in February last supersede those given in the annual report for 1886 (Appendix No. 12, pp. 290–407), no improvement can be made in the expression for the secular variation of the declination at San Francisco, for which place the calculated reversal from increasing easterly to decreasing easterly declination is predicted for 1893. At that time the declination will not sensibly differ from 16°36′ east, — its then extreme value. Owing to discord among the individual observations, these predicted years are subject to an uncertainty of several years; as shown, for instance, in the case of Monterey, for which the calculation appears to assign too late a date. The accurate observations

made at Los Angeles, at the Coast and Geodetic Magnetic Observatory, by means of automatic photographic registry, point to a very recent (just before the establishment of the observatory in 1882) occurrence of the maximum east declination at that place.

In passing up the Pacific coast, we notice everywhere in Oregon and Washington Territory that either the reversal of the secular motion has already occurred, or is about to occur shortly. The present is therefore a very important epoch in the science of terrestrial magnetism as relating to our western coast, and hence demands special watchfulness on the part of the survey, in order that its charts may show our latest knowledge respecting this, to the navigator, most important information. C. A. S.

Washington, Sept. 21.

Archæological Remains in the Costa Cuca (Guatemala).

DURING my late archæological tour through Central America, I met an intelligent countryman of mine, Mr. Hermann Wundram, who spoke very enthusiastically of the mounds and idols on the coffee-plantation Santa Margarita, of which he is the *administrador*. After having visited the ruins of Iximché, Utatlan, and other places of historical interest in the Altos of Guatemala, and being anxious to see these remains, of which, to my knowledge, no explorer has made any mention, I rode from Quetzaltenango down to Retalhuleú, in whose vicinity they are situated.

Scattered over a vast area on the plantations of Santa Margarita and San Isidro, they consist of foundation-walls of stone edifices, and of a number of mounds of different heights and circumferences, either single or in pairs. One of the mounds has been used until recently as a burial-ground by the Indians. Their relative position cannot be determined, as the dense coffee-plantations can be penetrated but with the utmost difficulty.

In the neighborhood of the mounds stand upright sculptured monoliths, or lie half buried in the ground. On two of these appears in low relief the figure of a twisted serpent, surrounded by ornamental scrolls artistically executed. The ornaments have, however, no resemblance to Mexican picture-writings or to Maya hieroglyphs. One of the serpents looks at a rectangular shield in the centre of the slab, 13 inches high and 9 inches wide, and divided into four panels, the upper panel ornamented with two figures such as here given.  This stone is 4 feet 6 inches wide, 5 feet above and 1 foot 6 inches below the ground. In front of it stood a half-burned tallow candle, as an offering of the Indians, who adore these relics of their ancestors as saints, — a queer mixture of Pagan heathenism and Christian belief.

The other stone is 3 feet 8 inches wide and 4 feet 4 inches high, but the upper portion is broken off. On several of the monoliths the figures are so much obliterated, that only a few triangles and rectangles in groups can be made out; and on one of them, apparently of grayish marble (12 feet 9 inches high and 5 feet wide), but a few lines could be distinguished. A stone figure (5 feet 9 inches high and 3 feet 2 inches wide) representing the upper half of a man, and resting on a double base of oval form (4 feet wide), had but four fingers on the clumsy hands; and of the square face, only the broad-cornered nose and half of the right eye could be recognized. At the side of the figure lay a small statue, probably that of a child, with mutilated arms and broken-off head.

Near by was a cylindrical stone, of 28 inches diameter, in the form of a millstone, with a cavity of 22 inches diameter in the centre, and a half-oval annex at the lower end. A similar stone found here, but without the annex, had been placed on one of the corners of the yard in front of the planter's residence. The central cavity was of the same width as that of the former stone, but the margins were partially ornamented. I could not make out any other explanation of their use, but that these stones had served as receptacles for the hearts of the victims, after these had been torn from the breast; at least, they had a striking resemblance to the Cuauhxicalli of the ancient Mexicans.

At another side of the yard stood the sculptured bust of a man, also found in the ruins, 3 feet high, and resting on a base 11 inches high. The face was nearly round; eyes, nose, mouth, and rectangular ears, very large; the forehead low and much receding; the arms bent over the chest, with no hands; the back flat, as having leaned against some object. An obtuse-angled collar, reaching to the middle of the chest, seems to indicate that the figure represents a chieftain.

The rude and clumsy stone figures contrast strangely with the admirably correct and artistically executed reliefs of the monoliths: hence the inference seems to be justified that both belong to different peoples and different periods, — an inference which indeed is confirmed by the tradition of the Indians. They report that a city flourished here many years ago, but that it was destroyed by the Chinantecos. The latter term is derived from *chinamitl*, a Nahuatl word which signifies 'an enclosure of reeds' (*Seto ó cerca de cañas; chinantia, hacer seto* — Molina). The *Chinantecos* are therefore the makers and inhabitants of such enclosures. But to what known tribes does the term refer? When I travelled from Lake Atitlan, the most beautiful I ever saw, to Chichicastenango, and from Santa Cruz del Quiché to Totonicapam,— districts still inhabited by the Quichés and Cakchiquels,— I discovered the interpretation of the name. The dwellings of these Indians, mere huts of reeds and wooden sticks, nestle on the declivities of the hills or in the ravines, surrounded by *milpas*, and enclosed by fences of the above material, often scattered over an area of a square league. It is the same mode of settlement, which, according to Ximenez, was even at his time peculiar to the Quiché tribes, and bespeaks their ancient social organization. A number of these *chinamitales* formed the *amac* ('clan, gens') ruled by an *ahagua*. These *ahaguas*, in turn, constituted the great council of the tribe, without whose consent nothing could be disposed of.

That in the Indian tradition above quoted the name 'Chinantecos' refers really to the Quiché tribes, is corroborated by other aboriginal testimony. Indeed, we know from the 'Popol Vuh' and from the 'Titulo de los Señores de Totonicapam,' that the Quichés had extended their conquests under Quicab, who seems to be identical with the Hunahpú of Iuarros and of the 'Isagoge Historico,' down to the Pacific coast. Furthermore, we know from the 'Titulo de los Señores de Quetzaltenango,' that the country between Mazatenango (Cakolqueh) and Mazatlan was tributary to the Quichés; nay, even in the list of tributes, fish from the rivers Samalá, Uquz (Ocos), Nil, and Xab are enumerated. The fact that the ruined city is situated between the two last-named rivers, renders it almost a certainty that its inhabitants belonged to these tributary tribes, and that, from giving their conquerors a Nahuatl name, they were of Nahuatl origin.

There is another circumstance which points in the same direction; namely, the feathered serpents on the sculptured monoliths. They doubtless bespeak a Quetzalcoatl cult, — a cult conspicuously flourishing among the Nahuatl tribes. Four immigrations of such tribes into Guatemala are recorded by the Mexican and Spanish historians. The first one is that of the Toltecs after the destruction of Tollan, the seat of their great council-house (Ixtlilxochitl); the second, that of the Mexicans and Cholultecas, driven from Soconusco by the Olmecas, part of whom settled in Guatemala and San Salvador as Pipiles (Torquemada); a third one took place during a famine under the first Mocteuhzoma (Motolinia, Gomara, Herrera, Oviedo); and the last one under Ahuizotl, who, at the end of the fifteenth century, sent soldiers, under the disguise of merchants, to the Pacific coast of Guatemala, in order to form a nucleus for subduing the Quiché tribes (Iuarros).

For chronological reasons, and from the fact that the Toltecs were the most advanced of the Nahuatl tribes in the arts, I am inclined to attribute to them the origin of the ruined city and of the monolithic slabs, while I would assign to the Quichés the rude stone figures, since the latter present some resemblance to the clay idols found by Stephens in the ruins of Utatlan.

But while the sculptures on the monoliths in Santa Margarita and San Isidro show the same artistic skill and taste as those in Santa Lucia Cotzumalguapa, they are quite different from those in Quirigua, which I visited later on. The reliefs are lower, the objects represented dissimilar, and hieroglyphs totally absent.

Careful explorations in the dense forests along the Pacific coast would undoubtedly reveal more ruins and sculptures similar to those of Santa Margarita, which, along with those of Santa Lucia, would give additional proof of the Toltecan occupancy of this territory. GUST. BRUEHL, M.D.

Cincinnati, O., Sept. 12.

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SCIENCE

FRIDAY, OCTOBER 5, 1888.

NOTWITHSTANDING THE EMPHATIC warnings of all experienced Arctic navigators, and the difficulties encountered on the 'Alert' expeditions, the projected route from England through Hudson Strait to Fort Churchill continues to be discussed in England and Canada; and quite recently the establishment of a line of steamers on this route was advocated by no less an authority than Commodore A. H. Markham, in a lecture delivered before the Royal Geographical Society. As he failed, however, to disprove any of the objections raised against the practicability of this route, which are chiefly founded on the always imminent danger of Fox Channel ice, his remarks fail to convince us. There is no doubt that powerful but small steamers can accomplish the journey annually with comparative safety, but this is far from being sufficient to make Hudson Strait a practicable trade-route. The premium on this route would have to be enormously high on account of the great number of dangers to navigation, and at all seasons the steamers would be liable to long delays. Sir Charles Tupper, who was present at this discussion, did not take as favorable a view as Markham, while Dr. Rae condemned the plan as wholly untenable. It seems somewhat surprising to see it again revived after its impracticability appeared to have been thoroughly proved by the results of the Canadian Hudson Bay expeditions.

A LESSON IN COMMERCIAL GEOGRAPHY.

SIR C. W. WILSON, in his presidential address to the geographical section of the British Association, dwelt upon the importance of commercial geography and its bearings upon the economic welfare of England. He gave a sketch of the history of the world's trade, and thus outlined one of the most important branches of commercial geography. His remarks on the value of this study, although referring to England, are well worth being remembered. "My object has been," he said, "to draw attention to the supreme importance to this country of the science of commercial geography. That science is not confined to a knowledge of the localities in which those products of the earth which have a commercial value are to be found, and of the markets in which they can be sold with the greatest profit. Its higher aims are to divine, by a combination of historical retrospect and scientific foresight, the channels through which commerce will flow in the future, and the points at which new centres of trade must arrive in obedience to known laws. A precise knowledge of the form, size, and geological structure of the globe; of its physical features; of the topographical distribution of its mineral and vegetable products, and of the varied forms of animal life, including man, that it sustains; of the influence of geographical environment on man and the lower animals; and of the climatic conditions of the various regions of the earth, — is absolutely essential to a successful solution of the many problems before us. If England is to maintain her commanding position in the world of commerce, she must approach these problems in the spirit of Henry the Navigator, and by high scientific training fit her sons to play their part like men in the coming struggle for commercial supremacy. The struggle will be keen, and victory will rest with those who have most fully realized the truth of the maxim that 'knowledge is power.'"

His lucid method of treating the questions of commercial geography will be seen from his interesting remarks on the Suez Canal, which are the more interesting, as they suggest a comparison to the effects of a canal through the American Isthmus.

"The opening of the Suez Canal, by diverting trade from the Cape route to the Mediterranean, has produced, and is still producing, changes in the intercourse between the East and the West which affect this country more nearly, perhaps, than any other European state. The changes have been in three directions.

"First, An increasing proportion of the raw material and products of the East is carried direct to Mediterranean ports, by ships passing through the canal, instead of coming, as they once did, to England for distribution. Thus Odessa, Trieste, Venice, and Marseilles are becoming centres of distribution for Southern and Central Europe, as Antwerp and Hamburg are for the North; and our merchants are thus losing the profits they derived from transmitting and forwarding Eastern goods to Europe. It is true that the carrying-trade is still, to a very great extent, in English hands; but should this country be involved in a European war, the carrying-trade, unless we can efficiently protect it, will pass to others, and it will not readily return. Continental manufacturers have always been heavily handicapped by the position England has held since the commencement of the century, and the distributing trade would doubtless have passed from us in process of time. The opening of the canal has accelerated the change, to the detriment of English manufactures, and consequently of the national wealth; and it must tend to make England less and less each year the emporium of the world. We are experiencing the results of a natural law that a redistribution of the centres of trade must follow a re-arrangement of the channels of commerce.

"Second, The diversion of traffic from the Cape route has led to the construction of steamers for special trade to India and the East through the canal. On this line coaling stations are frequent, and the seas, excepting in the Bay of Biscay, are more tranquil than on most long voyages. The result is, that an inferior type of vessel, both as regards coal-stowage, speed, endurance, and seaworthiness, has been built. These 'canal wallahs,' as they are sometimes called, are quite unfitted for the voyage round the Cape, and, should the canal be blocked by war or accident, they would be practically useless in carrying on our Eastern trade. Since the canal has deepened, they have improved, for it has been found cheaper to have more coal-stowage, but they are still far from being available for the long voyage round the Cape. Had the canal not been made, a large number of fine steamers would gradually have been built for the Cape route, and, though the sailing-ships which formerly carried the India and China trade would have held their own longer, we should by this time have had more of the class of steamer that would be invaluable to us in war-time; and our trade would not have been liable, as it is now, to paralysis by the closing of the canal.

"Third, Sir William Hunter has pointed out, that, since the opening of the canal, India has entered the market as a competitor with the British workman; and that the development of that part of the empire as a manufacturing and food-exporting country will involve changes in English production which must for a time be attended by suffering and loss. Indian trade has advanced by rapid strides, the exports of merchandise have risen from an average of fifty-seven millions for the five years preceding 1874 to eighty-eight millions in 1884, and there has been an immense expansion in the export of bulky commodities. Wheat, which occupied an insignificant place in the list of exports, is now a great staple of Indian commerce, and the export has risen since 1873 from one and three-quarters to twenty-one million hundredweights. It is almost impossible to estimate the ultimate dimensions of the wheat trade, and it is only the forerunner of other trades in which India is destined to compete keenly with the English and European producers.

"The position in which England has been placed by the opening of the canal is in some respects similar to that of Venice after the discovery of the Cape route; but there is a wide difference in the

spirit with which the change in the commercial routes was accepted. Venice made no attempt to use the Cape route, and did all she could to prevent others from taking advantage of it: England, though by a natural instinct she opposed the construction of the canal, was one of the first to take advantage of it when opened, and, so far as the carrying-trade is concerned, she has hitherto successfully competed with other countries."

It is hardly possible to imagine what the effect of the American canal will be. Its influence is likely to be undervalued in Europe, as it will undoubtedly far more benefit the United States than European states. It will undoubtedly cause a revolution of the Eastern carrying-trade, and wrest from England's hand the profit obtained by distributing many Eastern goods over Europe and America.

The importance of geography, and more especially of commercial geography, has recently been emphasized by many English writers, and nowhere has this science more ably been advocated than in C. W. Wilson's address, from which we quoted above. If this science is important to England, it is even more important to us who have to develop the unknown resources of our vast territory. There can be no doubt that from an intelligent pursuit of this science great benefits would accrue to the welfare of our country.

THE LOCATION OF THE NICARAGUA SHIP-CANAL.

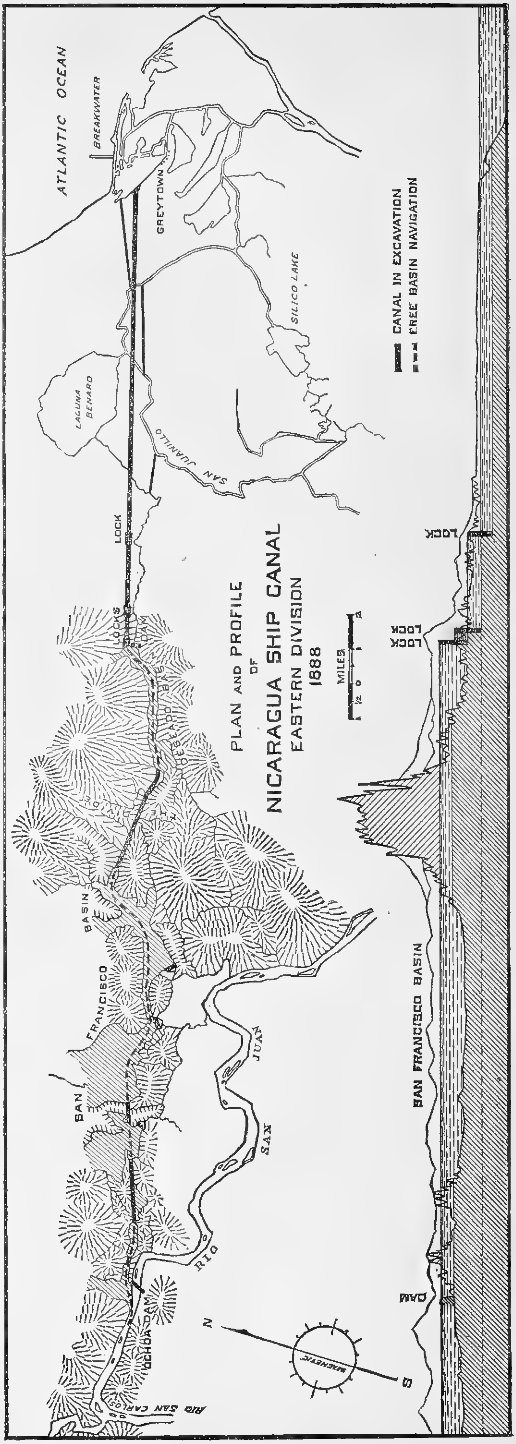
THE result of the surveys for the final location of the Nicaragua Canal, just completed by the Nicaragua Canal Construction Company, are highly satisfactory, and confirm with marked precision the great advantages, in both a financial and engineering point of view, claimed for the route recommended after the survey of 1885. Limited time and insufficient force for extensive field-work made a portion of that survey preliminary in its character; and, while the route selected was regarded as perfectly practicable, yet there were important details of construction and possibilities for improvements which could only be definitely settled by a more exhaustive examination of the newly traversed ground.

It has been the object of the last surveying expedition to eliminate all those doubtful elements, and to perfect the final plans for the work, from the Atlantic to the Pacific, before the scheme is finally presented to the public by the promoters of the enterprise.

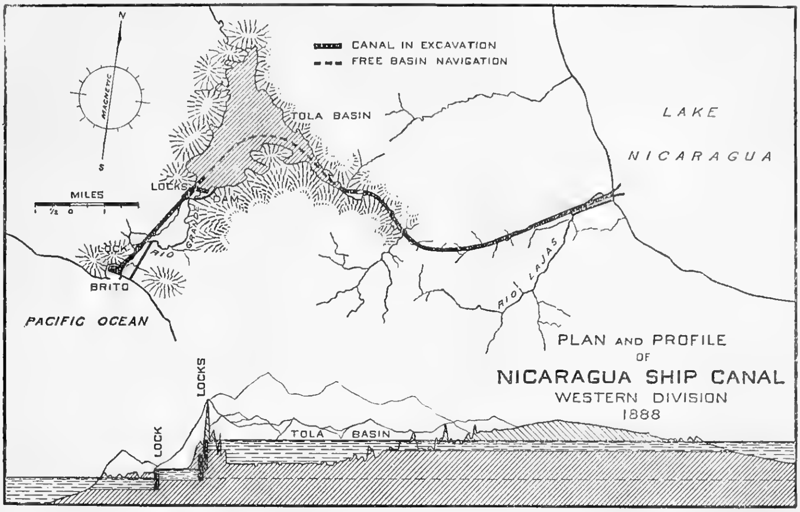
The work accomplished is highly creditable to the Construction Company. No expense or personal efforts have been spared to bring out the whole truth; and the detailed drawings representing the entire route, the geological specimens, the results of many borings of the ground, and much other valuable information bearing on the subject, now in possession of the company, bear testimony to the sound and honest intention of the promoters of this great enterprise not to go before the public until they are fully prepared to answer all questions, and to show with unusual accuracy the probable cost of the entire work.

The recent surveys extended over the whole ground; and after discarding those routes, or portions of routes, possessing the least merit, the whole force of the expedition was concentrated on those two presenting the greatest facilities for the construction of the canal. The difference between these two routes was confined to that portion extending from Greytown to the dam at Ochoa, there being no difference of opinion as to the best location between this latter point and the Pacific. Two routes had been suggested from Ochoa to Greytown, — one, the result of the survey of 1885, and called the 'upper route' on account of its striking feature of extending the summit or lake level across the basin of the river San Francisco and the 'eastern divide' to within a short distance of Greytown; the other, or 'lower route,' the result of the survey of 1872–73, extending through the lower valleys, and in close proximity to the river San Juan, to the divergency of the stream San Juanillo, an outlet of the San Juan River, and thence by a direct line to Greytown. Both routes have been re-examined and located with the same care, and with that precision which seems to control the work of the company; and a careful comparison of the results obtained shows the superiority of the upper route.

As now finally adopted, the location does not differ in general direction, controlling features, or total length, from that of 1885; but the last, more minute surveys have established beyond a doubt



the practicability of important improvements, which were only suggested as possibilities after the previous, more preliminary survey, and which will materially contribute to reduce the cost of the work by increasing the length of free navigation through basins, and proportionally increasing the capacity of the canal with a marked reduction of the working-expenses.



The route extends from Greytown, on the Atlantic, to Brito, on the Pacific, a distance of 169.67 miles, divided as follows: —

	Free Navigation.	Canal in Excavation.
From Greytown to the Deseado basin	–	12.37
Deseado basin	4.00	–
From Deseado basin to San Francisco basin	–	3.07
San Francisco and Machado basins	11.00	1.73
River San Juan	64.00	–
Lake Nicaragua	56.50	–
From Lake Nicaragua to Tola basin	–	8.22
Tola basin	5.28	–
From Tola basin to Brito	–	3.50
Total miles	140.78	28.89

The Deseado and Tola basins are new features brought out by the last location, as well as an increase of 2.13 miles in the length of free navigation in the San Francisco and Machado basins: in other words, the last location has reduced the length of canal in excavation from 40.3 to 28.89 miles, or 11.41 miles, and has increased the free navigation by that same distance; while the summit level has been extended from 144.8 miles to 153.8 miles.

It will require some time to complete the estimates of cost on the new location; but it may be safely stated that at least ten per cent will be gained in the total cost based on the survey of 1885, which is $64,036,197, including twenty-five per cent for contingencies.

THE BROOKLYN INSTITUTE.

RATHER more than fifty years ago a library association was formed in the city of Brooklyn, which grew in scope and usefulness, until in 1843 its charter was amended, and the name changed to that of the Brooklyn Institute. Courses of lectures were delivered from time to time, including in the list of speakers such men as Agassiz, Dana, Gray, Henry, Torrey, Guyot, and Cooke. Several important bequests made the institute financially strong, and its public hall was a favorite place of social gathering, aside from its main purpose of public instruction.

As time advanced and Brooklyn grew in size, the Academy of Music and other public buildings were erected, and the institute building waned in popularity. In 1867 the directors found it advisable to remodel the interior at an expense of thirty thousand dollars, which necessitated a mortgage on the building. Since that time, until quite recently, the entire income from its endowment fund has been absorbed in payment of the interest and principal of this debt. Final payment on the mortgage was made early in 1887.

The property now consists of the institute building and land, near the entrance to the great bridge, a library of fifteen thousand volumes, and endowment funds to the value of forty-six thousand dollars. The income from this is now applied to the purpose for which it was originally intended, and about a year ago the institute began upon a new era of activity.

One part of the endowment fund, bequeathed in 1851 by Augustus Graham, is devoted to the support of a limited course of Sunday-evening lectures on 'The Power, Wisdom, and Goodness of God as manifested in his Works.' In accordance with this requirement, lectures were delivered last winter by Sir J. William Dawson of Montreal, and by Dr. Alexander Winchell of the University of Michigan. Another part of the Graham fund is for the support of lectures on scientific subjects on other evenings of the week, and without specific restriction of topic. An introductory course of six lectures on astronomy was given last autumn by Prof. C. A. Young of Princeton. This was followed during the winter by another course, including topics in physics, geology, astronomy, and architecture. The lecturers were Messrs. George W. Plympton, W. LeConte Stevens, William C. Peckham, Franklin W. Hooper, and Garrett P. Serviss, of Brooklyn, and Dr. J. S. Newberry of New York.

Meanwhile steps had been taken with a view to the organization of a scientific society, with the Brooklyn Institute as its home. A meeting for this purpose was held in February, 1888, resulting in the adoption of by-laws and the formation of a council. Of this, Dr. Charles E. West was elected president, and W. LeConte Stevens secretary. Soon afterward the Brooklyn Microscopical Society and the American Astronomical Society became merged in the Brooklyn Institute as special departments of that body. The by-laws provide for departments in every branch of science, including anthropology, architecture, astronomy, botany, chemistry, en-

gineering, entomology, fine art, geography, geology, microscopy, mineralogy, photography, physics, and zoölogy. The associate members of the institute thus constitute a federation of independent departments; but a single admission-fee being required for associate membership, while each member has the privilege of joining as many departments as may be suggested by his individual tastes. For the origination of this plan, as well as for the burden of the work of organization, the credit is due chiefly to Mr. F. W. Hooper, of the Adelphi Academy, Brooklyn.

Aside from the meetings of departments, general meetings of the associate members are periodically held in connection with a course of public lectures. The opening lecture of the first course was given last April by Mr. W. LeConte Stevens, who was followed in successive weeks by Messrs. Robert Spice, George M. Hopkins, and Garrett P. Serviss. The season was closed with an exhibition by the department of microscopy, which was largely attended and in every way successful. The attendance at the public lectures was at first about three hundred, but grew to more than five hundred with the progress of the season.

Departments of entomology and of physics have been organized in addition to those already incorporated in the institute, and others will soon be started in chemistry, mineralogy, and botany. The department of physics held its first meeting on the evening of Sept. 26, when Mr. G. M. Hopkins exhibited a variety of apparatus, largely of his own device, illustrating centrifugal motion and the gyroscope. This was followed by a discussion of the latter instrument introduced by Mr. W. LeConte Stevens and participated in by various other members of the department.

The public lecture course for the coming winter has been already arranged, the opening lecture, on the 11th of October, being by Mr. Bradford of New York, the well-known artist and arctic explorer. Harvard, Yale, Columbia, and the scientific departments at Washington are well represented in the list of lecturers. S.

THE AGASSIZ SEASIDE ASSEMBLY.

AT the May meeting of the New Jersey Assembly of the Agassiz Association, held at Rutgers College, New Brunswick, N.J., it was decided to hold a seaside assembly, open not only to members of the Agassiz Association generally, but to all persons interested in the study of natural science. A committee was appointed, with power to make all necessary arrangements. Asbury Park was selected as the place, and the week beginning with Aug. 6 as the time, for the meeting; and Educational Hall was secured for the purpose. Circulars were sent to all the chapters in New England and the Middle States, and also to many persons interested in scientific studies, who were not members of the association. The assembly met on the day appointed, in Educational Hall, Asbury Park. The opening lecture was delivered by Harlan H. Ballard, president of the Agassiz Association, and it was a most inspiring introduction to a week of very successful and delightful work. The mornings of the remaining days of the week were devoted to field-excursions in botany and entomology, the former under the guidance of the Rev. L. H. Lighthipe, and the latter under the Rev. G. D. Hulst, the State entomologist of New Jersey. Tuesday afternoon was devoted to the examination and analysis of plants, many of which, belonging to the 'pine-barrens,' were quite new to most of those present. A paper upon the 'Flora of New Jersey' was contributed by the Rev. L. H. Lighthipe of Woodbridge, N.J., the president of the New Jersey Assembly. On Wednesday afternoon a *conversazione* on 'How to use the Microscope' was held by Prof. F. C. Van Dyck of Rutgers College. Remarks upon the subject were also made by Prof. George Macloskie of Princeton, who also exhibited a most convenient apparatus for the dissection of flowers and insects. In the evening a most interesting lecture upon diatoms was given by Prof. Samuel Lockwood of Freehold, N.J., illustrated by means of the stereopticon. Professor Lockwood has made these interesting microscopical plants the study of his lifetime, and consequently spoke from his own personal observations. His lecture was enjoyed by all; and the fact that his audience could see before them objects which are only visible by means of the microscope, magnified many thousand times, — we might almost say millions, — added very much to its interest. Thursday was an entomological day. The excursion in the morning was conducted by the Rev. G. D. Hulst, and the afternoon was devoted to the examination of insects collected, and to remarks by the same gentleman upon the collection, preservation, and classification of entomological specimens. In the evening a lecture upon seaweeds was given by Isaac Holden of Bridgeport, Conn. This, like the lecture on diatoms, was made doubly interesting by means of the stereopticon. Mr. Holden also exhibited a large number of beautifully mounted specimens collected by him in the vicinity of his home at Bridgeport. On Friday afternoon, after the examination of the plants collected in the morning, a very instructive lecture was given by Prof. T. O'C. Sloane of the *Scientific American*, and author of 'Home Experiments in Science,' on 'How to make Scientific Experiments with Simple Apparatus.' This was illustrated by actual experiments in physics, made with very simple and inexpensive apparatus. It was a surprise to every one that so much could be accomplished, and so many experiments performed, at so trifling a cost.

The Seaside Assembly adjourned at the close of this lecture, every one present feeling that a very profitable week had been spent. The attendance was not so large as expected, but those who were present felt fully repaid for their coming. A universal desire was expressed that the assembly be held again next summer, and the committee of arrangements were requested to do what they could to accomplish this result. Should this be done, it is hoped that a large number of the chapters will take an active interest in the assembly. Rev. L. H. Lighthipe, Woodbridge, N.J., is chairman of the committee of arrangements, and as such he will be most happy to receive any suggestions that may be offered.

SCIENTIFIC NEWS IN WASHINGTON.

The Library of the Geological Survey: Strong in its Special Fields. — Light and Tree-Growth: Influences of Site and Atmospheric Conditions.

The National Geological Survey Library.

ONE of the most important and practically useful adjuncts of the National Geological Survey is its excellent library. The collection was begun in 1881, almost simultaneously with the establishment of the survey; and in the seven years that have elapsed, about twenty-five thousand bound volumes and more than forty thousand pamphlets have been accumulated. The first important acquisition of the library was in the fall of 1882, when Mr. Darwin, the librarian, negotiated the purchase of the Robert Clarke geological library in Cincinnati. It comprised about two thousand volumes, consisting principally of the reports of State geological surveys. This was the nucleus of what has become the most complete collection of State, United States, and foreign official reports of geological surveys now in existence. There are probably between four thousand and five thousand volumes in this department of the library, including many reports that are rare, and sets that it would be very difficult to duplicate. Of course, even this part of the library is not complete; but it is more nearly so than any other similar collection, and additions are frequently being made to it. It is in constant use by members of the survey preparatory to field-work.

The division of official reports is arranged in the following order: in the first sections are the reports of State surveys classified geographically. This portion of the department comprises a larger number of books than either of the others; and its practical value to the National Survey, as evidenced by its constant use, can hardly be overestimated. The careful study of its volumes prevents the duplication by the National Survey of work already done, and available. It may be interesting to note, in passing, that the first geological report authorized by a State legislature in the United States was ordered by the legislature of North Carolina, and published as a 'memoir' in 1819. It is a thin volume, treating of other topics in addition to the brief and very vague chapters on the geology of the State.

A succeeding portion of this same division contains a very full collection of reports of early United States Government surveys, reconnaissances, etc. Most of these were made under the direction

of the war department, and are especially interesting for the pictures they preserve of the vast area between the Missouri River and the Pacific Ocean before it became accessible to any except military expeditions, specially equipped exploring parties, trappers, and missionaries. Adjoining this section are complete sets of the reports and publications of the several surveys that preceded the National Geological Survey, and from the combination of which it was organized, — the Hayden, Powell, King. Nothing needs to be said of the practical value of this collection. The work of all of these surveys is being embodied in the maps prepared under the direction of Major Powell, and a large portion of it is found available, and adaptable to the uniform system adopted by the National Survey. These comprise all the official geological reports; but they are supplemented by a very full collection of United States Government reports on miscellaneous subjects, principally the resources and industries of the United States and of detached portions of the country. The National Survey itself, or different members, including Major Powell and several of his chief assistants, have made valuable contributions, in the form of reports, monographs, or bulletins, to our knowledge, especially of the resources of the less-understood portions of the country; and some of the most important work now in progress under the direction of the Nationa Survey has to do directly with economic subjects. l

Lastly, in the division of official reports, are those of foreign countries. Canada has an excellent geological survey, and its publications are very valuable. European reports are arranged geographically, beginning with those of Russia. France and Germany have no geological surveys, but their commissions to make geological maps of those countries have made important reports. The collection of foreign reports is large.

Second in importance to the division of official reports, is the excellent collection of the transactions and proceedings of geological societies, those of scientific societies, and bound files of scientific periodicals. These occupy a large space in the library, and are constantly put to practical use.

The library has been recently enriched by the purchase in Paris of six hundred and twenty-five volumes, a part of the private library of Desnoyers, a distinguished geologist and writer, and librarian of the Paris Museum of Natural History. Many of these books are presentation copies, containing the autographs of their authors. The books purchased comprised nearly all offered in the divisions of geology, coal, glaciers, artesian wells, volcanoes and earthquakes, the geology of individual countries, mineralogy, and paleontology. Many of these books are rare, and their acquisition greatly enriches the library. A carefully selected general reference-library completes our survey.

In the bibliographical department a card-catalogue of authors, embracing the entire library of books and pamphlets, and consisting of several hundred thousand separate entries, has been finished. In addition to this, there is now in process of preparation a bibliography of North American geology, — a work that will require several years to finish, — and also a bibliography of the official geological reports of the States and of the United States Government. The work upon the latter has been about one-third done.

Probably there is no department of the National Survey library more highly prized than that of maps. Of these there are about twenty thousand, arranged geographically in drawers which admit of their lying flat. None of these are maps made by the National Survey, but they have been gathered from every available source, and constitute the largest and best collection of maps in the United States. A complete catalogue has been prepared, and the larger part of the maps are mounted on linen.

The library is admirably housed. The room devoted to its use is well lighted and ventilated, and not only admits of a most advantageous arrangement of the books, but it also affords excellent facilities for the work of the librarian's assistants, and conveniences for those who have occasion to consult the books.

The Influence of Light upon Tree-Growth.

Among the interesting discussions to be found in Professor Fernow's second annual report on forestry is a brief consideration of the influence of light upon the development of various trees of the forest. The following extracts give the essential portions of it: —

"It is a well-known fact that light is necessary for the development of chlorophyl, and therefore for the life of all green plants, and especially for tree-life and wood-formation. Heat alone, which practically always accompanies light, is not sufficient for this purpose, although it is still an open question as to what the absolute light-requirement of a tree species may be, or how much of the effect of increased light on growth is attributable to the light alone, and how much to the accompanying heat. Yet it is undeniable that there exists a relative difference of light-requirement, not only for different species of trees, but for all other plants.

"In last year's report I alluded to this difference in regard to the forest-weeds, which serve in forest management as an indication of the amount of shade which the trees exert, and with that their capacity of impeding evaporation from the soil. While the rosin-weed, sunflowers, some of the golden-rods (*Solidago nemoralis*), and some of the meadow-grasses, and the fire-weed (*Erechthites hieracifolia*), may be mentioned as requiring full sunlight for their best development, the Indian pipe (*Monotropa*) is most decidedly averse to a high degree of light. The partridge-berry (*Mitchella repens*), and among the grasses *Poa flexuosa, brevifolia, Festuca nutans, Cinna arundinacea*, may be named as seeking the shade. The ground hemlock and rhododendron are also characteristic shade-plants. By careful observation we could make a classification of weeds characterized by their dependence for normal development on various degrees of light and shade.

"The frequently observed change or 'alteration' of the flora, when the original forest is removed, must to some extent be explained by this light-influence.

"The amount of light required is, however, considerably modified by other influences of site. Where the intensity of the sunlight is great, as in southern countries, in higher altitudes, and in dryer climates, and also where the growing season is longer or the number of sunny days greater, a shade-enduring species will be able to sustain still more shade, and a light-needing one may even become shade-enduring. The flora of high altitudes, therefore, is in general decidedly light-needing. The elms, oaks, and ashes, which in northern latitudes are clearly light-needing, may in southern latitudes endure considerable shade.

"Trees are no exception to this rule; and while nearly all develop best, i.e., make the most wood, in the full enjoyment of light, their capacity of preserving their vitality and of developing under the shade varies greatly. While the yew will thrive in the densest shade, a few years of overtopping will kill the larch; so, also, while the beech will grow with considerable energy under the partial shade of such trees as ash, maple, etc., the oak will only just keep alive under the same conditions, and some of the birches would die.

"Favorable moisture-conditions make all species less sensitive to the withdrawal of light; and here, perhaps, the influence of the heat which accompanies the sunlight plays an important part. Therefore, on the fresh soils of bottom-lands, on northern exposures, and in the coves and depressions in the mountains, the light-needing species will be found to suffer less from shading than on dry, poor soils. Even so shade-enduring a species as the spruce becomes sensitive to the withdrawal of light when growing on dryer mountain-sites.

"The observations by which we may arrive at a relative classification of our timber-trees with regard to their light-requirements must therefore be made with due consideration of these modifying influences. The capacity to withstand shade, even in later life (in their youth most trees will stand considerable shade), is noticeable in the denser or less dense foliage, and in the capacity of overtopped individuals or overshaded branches to preserve their vitality for a longer or shorter time. The observations on this line must, then, be made in the dense forests, in order to be able to judge of their characteristic foliage-development in the shade; for, if grown in the open, so much light is accessible to every part of the crown, that leaf-development, even in the interior of the crown, is unimpeded, and quite a dense foliage is the result. Thus, in the open, the maples, elms, sycamores, black locusts, etc., make good shade-trees, while in the dense forest they thin out and have but scanty foliage. The conifers, which, like the spruces and firs, preserve the foliage of several years, have perhaps the greatest capability of growing under shade, and preserving their foliage, in spite of the

withdrawal of light. But, in the present state of our knowledge, we become painfully aware that we are lacking sufficient data to group even our most important forest-trees in a series according to light-requirements. This is not so, however, in Europe. Some forty years ago German foresters made observations along this line, formulating them and elaborating rules for the management of the various species, especially in thinning, mixing, and cutting for reproduction; and, although these rules have been practised for so long a time based on empirical knowledge, it is only now that Dr. Kienitz offers a physiological explanation of the difference in the behavior of trees under changing light-conditions. He found that on the same branch those leaves which are developed under the full influence of the sunlight are not only, as was known before, often larger and always tougher in texture, and thicker, but they have a larger number of stomata (or 'breathing-pores'), than those formed under less exposure to sunlight. The same, of course, was observed in individual trees grown under shade and in full enjoyment of light. If, then, the trees which have their foliage formed under the shade of outgrowing neighbors are suddenly placed in different light-conditions, the foliage is not adapted to perform its function as energetically as the stronger light necessitates. The buds which are formed in deficient light, show also in their leaves a deficiency in the number of stomata; and in consequence the favorable influence upon wood-formation, due to increased light, for which the thinnings and interlucations are made, become in fact noticeable only the second year, when new buds, developed under the increased light-influence, have formed leaves adapted to the changed conditions. In conifers, which hold their leaves for several years, this adaptation naturally takes a much longer time; and under unfavorable conditions, if moved too suddenly from the shade into the light, they often lose their old foliage, and even die before the new foliage adapted to the light-influence is sufficiently developed to sustain the increased demand of respiration, transpiration, and assimilation.

"The importance of this knowledge becomes apparent when we attempt to formulate the rules for thinnings, etc. There is hardly any line of investigation, observation, and experiment more fruitful, and more needed for the practical purposes of forest planting and management, than to establish this relation of our timber-trees to light-conditions. The rational compositions and form of our plantations, their management and reproduction, are based upon this knowledge, and the proper application of it may be well termed 'the essence of forestry.'

"Observations and experiments, therefore, in regard to the dependence of our important timber-trees upon light-conditions, are among the first to be undertaken by the experiment-stations in the forest and in the nursery.

"Hand in hand with these experiments, will go, of course, the inquiries into the rate of growth and yield before alluded to. If there are old growths at hand, the influence upon the yield of thinning with consequent 'undergrowing' may be ascertained."

ETHNOLOGY.

The Prehistoric Race of Spain.

MESSRS. H. AND L. SIRET have published the results of their interesting archæological researches in south-eastern Spain, and from their finds trace the history of the primitive people inhabiting that country. The most ancient remains show this people living in the neolithic period; later on, copper and bronze were used. Thus the researches of the authors give interesting confirmation of the recently established fact, that a copper age preceded the bronze age in most parts of Europe. At the close of the bronze age, silver is first used, and fortified villages occur. At the same time the methods of manufacturing bronze are improved. No iron was found in any of the stations of this people. There were two modes of burial: the dead were buried in large clay vessels, or the corpses were burnt. Weapons, ornaments, tools, food, and earthenware are always found in the graves, of which about a hundred were explored. The latter have been studied by Jaques. The results of the latter are summarized by Kollmann as follows. First of all, the principal result is of great value: various races occurred among these early inhabitants. No history mentions the name of this people. Since the neolithic period it has remained in the same locality. The impression is, that its culture developed continuously without any breaks. Its origin and descent are unknown, but one fact is shown by the forms of the skulls: it was a European people, consisting of European types, the same as live at present in Europe, and which lived at a still earlier period in the caves of Estremadura and at the kitchen-middens of Mugem, or later on in the dolmens near Lisbon. A series of dolichocephalic skulls has been found with an average cranial index of 73.8, and long face. The nose is long and the orbit high. This is the exact counterpart of the long skull of the northern inhabitants of Europe. Besides these, Jaques found a short-headed race, also with long faces, high noses and orbits. Their type also occurs frequently in northern Europe. A third race is also brachycephalic, but its characteristics are a broad, flat face, and strong prognathism. Broca considers this type mongoloid. Nevertheless, from a study of the photographs contained in the work, we assume that this race also is of exactly the same type as the European broad-faced, short-headed races, and does not resemble the Mongols. Besides this, a race with broad faces and long heads, the Cro-Magnon race of French writers was found. The fundamental conclusion from these facts is, that in this early period the shores of the Mediterranean were inhabited by several European races. Kollmann considers this result a confirmation of his theory that the migrating European tribes spread early over the whole continent, and that all European peoples consist of a mixture of these earliest inhabitants.

THE EVOLUTION OF ORNAMENTS. — There are few branches of ethnology in which the usefulness of extensive collections becomes more evident than in the study of the development of ornament. It is only in collections of this kind that incidental ornaments can be distinguished from characteristic ones. Since Holmes's admirable study of American ornaments, a number of essays have been published, most of which refer to the islands of the Pacific Ocean. Some time ago we mentioned Dr. L. Serrurier's study of arrows from New Guinea, which was published in the *International Ethnographical Archive*. The May number of the *Journal of the Anthropological Institute* contains another paper on a similar subject. Mr. Henry Balfour has studied a collection of arrows from the Solomon Islands, which are on exhibition in the Pitt Rivers Museum at Oxford. The ornamental design of these arrows is invariably found immediately above the joints of the reed of which the shaft is made. It usually consists of a number of incised straight lines, blackened, and running parallel to the shaft, so as to form a band round it. Balfour shows that this design originated in the necessary smoothing-off of the joints. When this is done, the fibrous nature of the substance of the reed causes narrow strips to peel away along the length of the shaft. To prevent this peeling extending far, cross-notches were cut. This was the origin of the ornament, which was later on retained, even when other methods of smoothing off the joints were used. Balfour compares this ornament with those of reed arrows from other countries, and shows that it is probably confined to the Solomon Islands, other methods of ornamentation and of smoothing the joint being used by other peoples. He mentions only a single arrow from South America of a similar description.

HEALTH MATTERS.

Diagnosis of Human Blood.

THE diagnosis of human blood is discussed by Dr. Henry Formad in the *Journal of Comparative Medicine*. Especial attention is given to the methods of examining blood-stains and measuring the blood-corpuscles.

For testing the question whether a certain substance is blood or not, the spectroscope and chemical re-agents come into play; but for the recognition of human blood the microscope alone is of any value, and the sole method yet found available with this instrument is that of measurement of the corpuscular elements. The differentiation of mammalian blood from that of lower orders of animals is made easy by the fact that in mammals alone is the cell round and non-nucleated. The differentiation between the blood of man and that of lower mammals depends entirely upon the micrometer.

Only the following animals have corpuscles larger than man, i.e., larger than $\frac{1}{3200}$ of an inch; viz., the elephant, great ant-eater, walrus, sloth, platypus, whale, capibara, and (according to Wormley) opossum. Animals the corpuscles of which are slightly below man in size, i.e., having corpuscles from $\frac{1}{3500}$ to $\frac{1}{3200}$ of an inch average diameter, are the seal, beaver, musk-rat, porcupine, monkey, kangaroo, wolf, and guinea-pig. None of these are domestic animals. All other animals, including all domestic animals, have blood-corpuscles of a mean diameter less than $\frac{1}{3500}$ of an inch; and, in fact, those animals which, as a rule, are blamed for blood-stains found on the clothing and apparel of criminals (ox, pig, horse, sheep, and goat), have corpuscles with an average diameter less than $\frac{1}{4000}$ of an inch. He summarizes the facts as follows: —

1. The blood-corpuscles of birds, fishes, and reptiles, being oval and nucleated, can never be mistaken for human blood.

2. Fresh human blood cannot be mistaken, under the microscope, for the blood of any animal the corpuscles of which have a mean diameter of less than $\frac{1}{4000}$, or even $\frac{1}{3600}$, of an inch.

3. (*a*) If the average diameter of blood-corpuscles in fresh blood is less than $\frac{1}{4000}$, then it cannot possibly be human blood; (*b*) if the diameter is more than $\frac{1}{3500}$, then it may be human blood; (*c*) if the blood-corpuscles, after exhaustive measurement, give a mean diameter of more than $\frac{1}{3300}$, then it *is* human blood (provided it is not the blood of one of the wild beasts referred to).

The foregoing applies especially to the diagnosis of fresh blood. With regard to dried blood, it is claimed that this can be recognized just as readily, provided it has dried quickly. Blood that has dried slowly undergoes decomposition, and its morphology cannot be made out. A good liquid for remoistening blood is Müller's fluid; but perhaps the best is Virchow's solution, composed of thirty parts caustic potash and seventy parts water. At least five hundred measurements should be made in order to establish the average diameter of the cells.

If the corpuscles are spheroidal from absorption of moisture, or crenated from drying, they may still be diagnosed, because such changes are the same in the corpuscles of all animals, and have really their proportionate and corresponding ratio of alteration in form and diminution in size, the range or scale of diminution being always alike in the same animal.

The red blood-corpuscles that have become spherical from imbibition of liquid have thus presented in Dr. Formad's experiments the following average diameters in the various animals: 1. Man, $\frac{1}{4300}$ inch; 2. guinea-pig, $\frac{1}{4500}$ inch; 3. Wolf, $\frac{1}{4600}$ inch; 4. Dog, $\frac{1}{4800}$ inch; 5. Rabbit, $\frac{1}{4900}$ inch; 6. Ox, $\frac{1}{5600}$ inch; 7. Sheep, $\frac{1}{6700}$ inch; 8. Goat, $\frac{1}{8100}$ inch.

These figures show that the diameter of the artificially spherical corpuscles in each animal is just about one-third less than that of the normal bi-concave or disk-like corpuscles of the same animals.

The question has long been a mooted one, as to whether the microscope can be depended on to determine positively, or not, that a given specimen of blood is that of a human being. Dr. Formad believes that this can be done, while other microscopists of equal eminence deny the possibility.

VACCINATION. — That small-pox has greatly declined in England during the past fifty years is apparent from figures which have been published by Dr. Henry Thorne. From 1838 to 1842 the deaths from small-pox in England amounted to 57.2 per 100,000; in 1880–84 the death-rate was 6.5 per 100,000. He thinks that vaccination has not only a direct influence in causing this reduction in the number of victims to small-pox, but that it has also a tendency to decrease the liability to the disease of children of vaccinated parents. In this connection it is interesting to note that *The Medical Press* states, that, out of the five thousand children born every month in Paris, only a thousand are vaccinated by the medical officers appointed for that purpose. The remaining four thousand infants are therefore either vaccinated by private practitioners, or not at all. Seeing, however, that more than half the population apply for and receive gratuitous medical attendance, and that half the burials are gratuitous, it is very unlikely that all of the four thousand are vaccinated at the cost of the parents. It may fairly be assumed that a large proportion are not vaccinated at all, and that is why small-pox exists as an endemic disease at Paris, and does not disappear, as it has done, to a great extent, in Germany.

ELECTRICAL SCIENCE.

Experiments in Proof of the Electro-magnetic Theory of Light.

IN his presidential address before the mathematical and physical section of the British Association, Prof. G. F. Fitzgerald dwelt at length on the recent experiments of Hertz in Germany on the propagation of electro-magnetic disturbances. These experiments are of so much importance, and go so far toward confirming the electro-magnetic theory of light, that a brief *résumé* of the subject will not be untimely.

There have been for years two theories with respect to the action upon each other of quantities of electricity, and of elements of electric current. One held that the various phenomena were caused by direct action at a distance; the other, that they were due to the action of the intervening medium. With respect to the electrostatic phenomena, Faraday's discovery that the capacity of a condenser varied with different dielectrics between the conducting coatings, made the theory of direct action extremely improbable; and his work, with that of Maxwell, has put the theory of an action of the dielectric on a firm foundation.

With respect to electro-magnetic phenomena, however, the case is different. Maxwell, in his magnificent work on electricity and magnetism, developed the idea that electro-magnetic actions are dependent on the surrounding medium, and one of the results is the electro-magnetic theory of light. But there has been no direct and unquestioned proof that there really is such an action in the dielectric as Maxwell has supposed. To illustrate the fundamental ideas involved, suppose we have a condenser made of two sheets of tinfoil with glass between; and suppose, further, that we have a battery whose poles may be connected to the coatings of the condenser. If we suddenly connect the poles to the coatings, there will be a momentary current, which will last only long enough to charge the condenser, probably for only a small fraction of a second. Now, the general idea was, that there was a current in the battery, and in the wires used to connect it with the condenser; and the result was to charge the two coatings, one with plus, the other with minus, electricity; and there the action stopped. Maxwell's idea was, that the current, so long as it lasted, was perfectly continuous, but that in the glass plate the action consisted of a 'displacement' of electricity; that is, considering a number of planes drawn through the conductors and through the glass, perpendicular to the direction of current, the amount of electricity crossing any plane was the same at the same instant, but that in the glass the result was a state of strain, exactly as if a spring were bent. The amount of 'displacement' depends on the displacing force, — the electro-motive force of the battery. When the proper displacement has taken place, all further action ceases, unless the strain is too great, in which case the dielectric breaks down, and we have the well-known phenomenon of disruptive discharge. The amount of displacement determines the charge of the condenser. When the electro-motive force is removed and the coatings joined, the strain in the dielectric relieves itself, producing the discharge.

If we charge the condenser with an alternating current, we have in the glass continuous displacement currents, first in one direction, then in the other.

From this fundamental idea of looking to the dielectric for the really important part of the phenomena, Maxwell was led to consider the laws by which the vibration of electricity on a small conductor would be propagated in the surrounding medium. He found that the equations governing the propagation were essentially the same as those deduced from the elastic solid theory of light; and he found that the velocity of propagation of such a disturbance was equal to a certain electrical constant which has several times been determined, and which agrees, within the limit of experimental error, with the value of the velocity of light. He also showed a relation between the specific inductive capacity and index of refraction of substances, which has not been completely proved, but which is suggestively close.

Here the matter dropped for a while. The theory has been extended, notably by Rowland and Fitzgerald, to account for other phenomena of light, but no experimental evidence of a conclusive nature has been produced.

It had not been shown, until Hertz's experiments were made, that the vibration of an electric current would set up disturbances in the surrounding medium, — the assumption on which Maxwell's theory was based. Hertz proved this in the following way: conducting circuits have definite time-constants, just as stretched strings have definite periods of vibration; and a disturbance whose period is the same as the time-constant of the circuit will produce a greater effect than any other, just as a piano-string will vibrate if one sings the note to which it corresponds. Hertz produced electric vibrations of a short and definite period, — one hundred millionth of a second, of a wave-length of about two metres, — and studied the effect on a receiving-circuit of the same time-constant. The receiving-circuit had a short air-space in it, and sparks were observed leaping across this space. By placing the vibrator several wave-lengths from a reflector, and moving the receiver between the two, he observed that at certain distances the induced sparks were faint; then, on moving the circuit, they became brighter, then disappeared again, — phenomena exactly resembling Lloyd's bands in optics, due to interference. To quote Professor Fitzgerald, "Henceforth I hope no learner will fail to be impressed with the theory — hypothesis no longer — that electro-magnetic actions are due to a medium pervading all known space, and that it is the same medium as the one by which light is propagated; that non-conductors can, and probably do, as Professor Poynting has taught us, transmit electro-magnetic energy. By means of variable currents, energy is propagated into space with the velocity of light."

The experiments of Hertz have made Maxwell's theory of light more than possibly true, and it seems as though light must be hereafter considered as an electro-magnetic phenomenon.

A NEW SYSTEM OF ELECTRICAL DISTRIBUTION BY STORAGE-BATTERIES. — Mr. Henry Edmunds has brought out a new system of distribution by storage-batteries, that seems to have a good deal of merit. The systems that have been used have objections which Mr. Edmunds obviates. Mr. Crompton's plan for using batteries is to have a number of groups in series on the main line, taking the current for distribution from the ends of each group. The batteries are connected with the charging and discharging circuits at the same time. The obvious disadvantage of this plan is that a high potential cannot be used, since the lamp-circuit is liable to have its potential raised to the maximum of the charging circuit; and, with more than four hundred volts difference of potential at the dynamo terminals, this would be distinctly unsafe. The other system consists in having two sets of cells, one of which is being charged while the other is discharging. Mr. Edmunds's is a modification of the latter plan. If he wishes forty-eight volts in the lamp-circuits, he uses thirty-two cells, divided into four sets of eight cells each. Three sets in series are constantly connected with the lamp-circuit, while the fourth set is being charged. A device is provided by which the various sets are put in rotation in the charging and discharging circuits, remaining two minutes in the former, six in the latter. In changing from one circuit to the other, a resistance is put in place of the battery being charged, so the main circuit is never broken. By putting two sets in parallel for an instant, a break in the lamp-circuit is avoided. This plan has the advantage of allowing high electro-motive forces to be used without necessitating a double outfit of batteries; and the efficiency should be greater than when the cells are charged for a considerable period and then discharged.

BOOK-REVIEWS.

The Aryan Race. By CHARLES MORRIS. Chicago, Griggs. 12°. $1.50.

THE present volume is a concise and pleasantly written review of the results of recent investigations on the home and history of the Aryan race. It is intended to be a popular book; and its object — to make clear to the general reader these interesting questions and their solutions, so far as reached to-day — has been well accomplished. The author is careful to give the evidence favoring the various theories as to the origin of the Aryans; and, although he states as his own view that they probably originated in south-eastern Europe, he does not urge his opinion upon the reader, but allows him to draw his own conclusions from the evidence offered. In an introductory chapter the author discusses the division of mankind into races, and claims that the Caucasians are a branch of the Mongols. He even goes so far as to divide mankind into two races, — the Mongoloid and Negroid. Anthropologists will hardly concur with the author's views expressed in this chapter. He next sets forth very candidly the arguments advanced by various writers as to the early home of the Aryans, and continues to trace their migrations as compared to those of other races. From linguistic evidence he describes their early stage of culture, their ancestral and nature worship, and their political development. When the author, in the chapter on the development of language, turns to consider languages other than Aryan, he is somewhat too sweeping in his statements regarding them, and we find throughout the book that the author's desire to eulogize the Aryan race has led him to underestimate the merits of the rest of mankind. The history of the Aryans is followed in general outlines up to the present time; and the book concludes with a glowing prospect of the future, the author assuming that even the fastnesses of Central Africa will become the home of the conquerors of the world.

On the Study of Words. By R. C. TRENCH. New York, Macmillan. 16°. $1.

THIS is the twentieth edition of Archbishop Trench's charming book, revised by A. L. Mayhew. The editor has not made any change in the arrangement of the book, but he has purged it of all erroneous etymologies, and corrected in the text small matters of detail, according to the recent advances of the science of philology. He has done well in altering as little as possible of the author's work, for it would be hardly possible to increase the attractiveness of Trench's style, and of his method of treating his subject. He has set forth the charms of the study of etymologies in a way that can hardly be improved, and that will make every reader a friend of this science. It will also induce the reader to a thoughtful use of words; to considering their "poetry and morality," to use the author's words. It is hardly necessary to recommend the interesting little volume, for the fact that it was necessary to publish a twentieth edition is sufficient proof of its great merits.

The Essentials of Geography. By G. C. FISHER. Boston, N. E. Publ. Co. 8°.

THIS is one of the old-style geographies, which are of no educational value, and only adapted for rote work. It is the briefest possible compilation of geographical facts, arranged without any geographical or educational method. The statements are extremely meagre, and the author has not been sufficiently critical in selecting them to make his book an 'authority,' as he expresses himself in the preface. The book is accompanied by sketch-maps, by the use of which the author hopes to enliven the teaching of geography; which, however, are also only useful for a teacher who is satisfied with routine work, and with cramming the minds of his pupils with facts.

How the Peasant Owner Lives. By LADY VERNEY. London and New York, Macmillan. 12°. $1.

LADY VERNEY has collected some descriptions of the life of peasant-owners in France, Germany, Italy, and Russia, with the object of defending the large English and more particularly Irish estates. She dwells on the fact that small estates cannot be worked economically, especially where they consist of small detached sections. She shows more particularly the evil results of this system in France. The authoress sees the only remedy against these effects in the consolidation of these small estates in the hands of great land-owners and the abolishment of small farms. Her ideal is that the small farmer should not try to make his living out of the produce of his little patch of land, but that he should become a laborer on a large estate. She deems the attempts to consolidate farms, that have been made on the European continent, unimportant, and also hardly touches the state of the workingman-peasants, who earn money as workers in factories, but at the same time own small patches of land on which they raise some of the necessaries of life. From this point of view, she condemns the efforts to create a peasantry in Ireland, and concludes her book with a touching romance, 'A Yeoman's Home in the Dales Sixty Years since.'

Citizen's Atlas of American Politics, 1789–1888. By FLETCHER W. HEWES. New York, Scribner. f°. $2.

THIS atlas is a campaign publication of peculiar interest, as it gives a clear graphical insight into some of the questions at issue. A number of maps show the comparative condition of the tariff, and the wages of skilled and unskilled labor for any corresponding period during the past forty years. Wages and cost of living are compared, and import and export charts show the country's part in the trade of the world. A large map is devoted to the production of wool and the value of the total product of manufactures. The latter maps are compiled from the returns of the Tenth Census, and are very interesting. The distribution of the foreign-born population receives special attention, one large map showing its ratio to the total population, while four smaller maps show that of the Germans, Irish, English, and Welsh, and of British Americans. These charts have been taken from 'Scribner's Statistical Atlas of the United States.' The first charts of the atlas represent the political history of the country, giving at a single glance a view of the supremacy of parties and of the increase of the popular vote. Another series of maps shows the history of presidential elections. The atlas is of special interest at present, containing, as it does, valuable and accurate information on some of the most important questions to be decided by the imminent election.

PUBLISHERS' FALL ANNOUNCEMENTS.

Houghton, Mifflin, & Co.

IN the American Commonwealths Series, 'Indiana: a Redemption from Slavery,' by J. P. Dunn, jun.; and 'Ohio: Historical Sketches of the First Fruits of the Ordinance of 1787,' by Rufus King. Under the title 'American Religious Leaders,' — a series of biographies of men who have exerted great influence on the religious thought and life of America, — the following will be among the earlier issues: 'Jonathan Edwards,' by Prof. A. V. G. Allen; 'Charles Hodge,' by Pres. Francis L. Patton of Princeton; 'Francis Wayland,' by Prof. J. O. Murray of Princeton; 'Wilbur Fisk,' by Prof. George Prentice of Wesleyan University; 'Archbishop John Hughes,' by John G. Shea, LL.D.; and 'Theodore Parker,' by John Fiske. 'A Latin Grammar,' by E. A. Andrews and S. Stoddard (new edition, thoroughly revised by Henry Preble). 'Colonial Times on Buzzard's Bay,' by W. R. Bliss. 'The Critical Period of American History, 1783–89,' by John Fiske. 'The Chief Contents of the *Gentleman's Magazine*, from 1731 to 1868,' edited by G. Laurence Gomme, F.S.A. (in fourteen volumes): Vol. IX. 'Literary Curiosities;' Vol. X. 'Topography.' 'Essay on Language, and Other Papers,' by Rowland G. Hazard (new edition). 'Freedom of Mind in Willing; or, Every Being that wills a Creative First Cause,' by Rowland G. Hazard (new edition). 'Two Letters on Causation and Freedom in Willing,' addressed to John Stuart Mill, with other papers, by Rowland G. Hazard (new edition). 'Realistic Idealism in Philosophy Itself,' by Nathaniel Holmes (in two volumes, crown 8°, $5). 'Young Sir Henry Vane,' by James K. Hosmer. 'Ancient Rome in the Light of Recent Discoveries,' by Rodolfo Lanciani, with two maps and about 100 illustrations. 'The Soul of the Far East,' by Percival Lowell. 'The Law of Eqivalents, in its Relations to Political and Social Ethics,' by Edward Payson. 'Index to Periodical Literature' (first supplement, Jan. 1, 1882, to Jan. 1, 1887), by William Frederick Poole and William I. Fletcher, with the co-operation of the American Library Association. 'Books and Men,' by Agnes Repplier. 'The Riverside Natural History,' by a corps of forty-three writers, with full bibliography, over 2,200 woodcuts in the text, 168 full-page engravings, and 12 colored plates; in six volumes; sold only by subscription. 'Second Lessons in Arithmetic,' designed to follow Colburn's 'First Lessons,' by H. N. Wheeler. In preparation: 'Narrative and Critical History of America,' edited by Justin Winsor: Vol. I. 'America before Columbus;' Vol. VIII. 'The Later History of British and Spanish America.'

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'A Key to Mr. Charles Smith's "Conic Sections,"' by Charles Smith, M.A.; 'Macmillan's Geographical Series,' edited by Archibald Geikie, F.R.S.; 'Maps and Map-Making,' by Alfred Hughes, M.A.; 'An Elementary General Geography,' by Hugh Robert Mill, D.Sc.; and 'A Geography of Europe,' by James Sime, M.A.

G. P. Putnam's Sons.

'American Literature, 1607–1885,' Part II. (completing the work) 'American Poetry and Fiction,' by Charles F. Richardson; a second impression of Part I. 'The Development of American Thought.' 'Popular Tales from the Norse,' by Sir George Webbe Dasent, D.C.L., etc., with an introductory essay on the origin and diffusion of popular tales (third edition). 'The Best Books: A Reader's Guide to the Choice of the Best Available Books in all Departments of Literature down to 1887,' rewritten and much enlarged, compiled by William Swan Sonnenschein. 'A History of Greece,' by Evelyn Abbott, M.A., LL.D., fellow of Balliol College, Oxford (to be complete in three parts). 'Omitted Chapters of History disclosed in the Life and Papers of Edmund Randolph,' by Moncure D. Conway. 'Governor Chamberlain's Administration in South Carolina,' a chapter of reconstruction in the Southern States, by Walter Allen. 'American Orations,' edited by Alexander Johnston. 'The Life and Letters of Dr. S. Wells Williams,' author of 'The Middle Kingdom,' and many years missionary in China, by Frederick Wells Williams. 'Some Chapters on Judaism and the Science of Religion,' by Rabbi Louis Grossman. 'Emanuel Swedenborg,' an essay, by John Bigelow. 'Proverbs and Phrases of All Ages,' by Robert Christy. 'A Sketch of the Germanic Constitution, from the Early Times to the Dissolution of the Empire,' by Samuel Epes Turner. In the Series of the Great Cities of the Republic, II. 'The Story of Boston,' by Arthur Gilman. In the Story of the Nations Series, XIX. 'The Story of Turkey,' by Stanley Lane-Poole, assisted by E. J. W. Gibb and Arthur Gilman; XX. 'The Story of Media, Babylon, and Persia, including a Study of the Zend-avesta or Religion of Zoroaster, from the Fall of Nineveh to the Persian War,' a continuation of 'The Story of Assyria,' by Z. A. Ragozin; XXI. 'The Story of Mediæval France, from the Reign of Hugues Capet to the Beginning of the Sixteenth Century,' by Gustave Masson; 'The Story of Holland,' by James E. Thorold Rogers; 'The Story of Mexico,' by Susan Hale; 'The Story of Phœnicia,' by Prof. George Rawlinson. 'The Economic Interpretation of History,' being the substance of lectures delivered in Worcester College Hall, Oxford University (1887–88), by James E. Thorold Rogers. 'An Introduction to English Economic History and Theory,' by W. J. Ashley. 'Industrial Liberty, an Analysis of the Existing Conditions in the United States, with Special Reference to the Relations to the Public of Railways and Trusts,' by John Bonham. 'The Centennial of a Revolution,' an address by A Revolutionist. 'In Castle and Cabin, Talks in Ireland in 1887,' by George Pellew. 'Business,' by James Platt, F.S.S. (authorized American edition, reprinted from the seventy-fifth English edition). In the Questions of the Day Series, XLIV. 'The Present Condition of Economic Science, and the Demand for a Radical Change in its Methods and Aims,' by Edward C. Lunt; XLVII. 'The Tariff History of the United States, 1789–1888,' by Prof. F. W. Taussig; XLVIII. 'The President's Message,' with annotations of facts and figures, by R. R. Bowker; XLIX. 'Essays on Practical Politics,' by Theodore Roosevelt; L. 'Friendly Letters to American Farmers and Others,' by J. S. Moore. 'Suggestive Therapeutics, a Study of the Nature and Use of Hypnotism,' by Prof. H. Bernheim, translated by Dr. Christian A. Herter. 'The Insane in Foreign Countries, Notes of an Examination of European Methods of Caring for the Insane,' by the Hon. William P. Letchworth. In the German Classics for American Students, 'Selections from the Prose Works of Lessing,' edited by Horatio S. White.

Roberts Brothers.

'Harvard Vespers' — addresses to Harvard students by the preachers to the university — contains addresses by Francis G. Peabody, Phillips Brooks, Edward Everett Hale, Alexander McKenzie, George A. Gordon, and Andrew P. Peabody. 'The Book of Christmas,' descriptive of the customs, ceremonies, traditions, superstitions, fun, feeling, and festivities of the Christmas season, by Thomas K. Hervey, with all the original illustrations by R. Seymour. 'Franklin in France,' Part II. 'The Treaty of Peace and Franklin's Life till his Return,' from original documents, by Edward Everett Hale and Edward E. Hale, jun. 'The Study of Politics,' by Prof. W. P. Atkinson. 'New England Legends and Folklore, in Prose and Poetry,' with 100 effective character illustrations, from designs by Merrill and others (a new and cheaper edition). 'London of To-day, 1888,' by Charles E. Pascoe (fourth year of publication). 'The United States of Yesterday and of To-morrow,' by William Barrows, D.D. 'History of the People of Israel till the Time of King David,' by Ernest Renan, author of 'Life of Jesus.'

George Routledge & Sons.

'My Trip round the World,' by W. S. Caine, M.P. 'A Thousand Miles up the Nile,' by Miss Amelia B. Edwards (new edition). 'The Chess-Player's Manual,' by G. H. D. Gossip, with an American appendix by S. Lipschütz. 'The Handy Reference Atlas of the World,' by John Bartholomew, with 100 maps and plans, full geographical statistics, and a complete index. The sixty-three volumes forming Morley's Universal Library will be re-issued in twenty-one monthly volumes, grouped and arranged in historical order. The first of the series will be 'The Iliad of Homer, The Plays of Æschylus, The Plays of Sophocles;' 'The Plays of Euripides;' 'The Acharnians, The Knights and the Birds of Aristophanes, Treatise on Government by Aristotle, The Æneid of Virgil;' 'Fables and Proverbs from the Sanskrit (the Hitopadesa), Mediæval Tales, The Chronicle of the Cid;' 'The Imitation of Christ by Thomas à Kempis, Life of Cardinal Wolsey by Cavendish, Ideal Commonwealths.' The first volume of the Carisbrooke Library — a development of Morley's Universal Library (completed with its sixty-third volume), upon the same plan and under the same editorship as that series — will appear in October, 1888; subsequent ones, every other month. 'Schiller's Complete Works,' translated by Lord Lytton, Samuel T. Coleridge, and others; edited by Prof. Henry Morley. 'The Prime Ministers of Queen Victoria: including Sketches of Lord Melbourne, Sir Robert Peel, Earl of Derby, Lord Aberdeen, Lord Palmerston, Lord Beaconsfield, Mr. Gladstone, and the Marquis of Salisbury,' by George B. Smith. 'Lemprière's Classical Dictionary: containing a Copious Account of all the Proper Names mentioned in Ancient Authors, with the Value of Coins, Weights, and Measures used among the Greeks and Romans, and a Chronological Table' (new edition). 'About Robins: Songs, Facts, and Legends,' by Lady Lindsay. 'Warrior Kings from Charlemagne to Frederick the Great,' by Lady Lamb (new edition). 'Harry Treverton: a tale of Australian Life,' edited by Lady Broome. 'The Hunting of the "Hydra;" or, The Phantom Prahu,' a tale of adventure in Southern Africa, by Henry Frith.

Ticknor & Co.

'The Letters of Felix Mendelssohn to Ignaz and Charlotte Moscheles,' translated and edited by Felix Moscheles; 'Four Years with the Army of the Potomac,' by Regis De Trobriand, brevet major-general, U. S. Vols., translated by George K. Dauchy, with maps, and a steel portrait of General De Trobriand; 'The Other Side of War, with the Army of the Potomac, Letters from Headquarters of the United States Sanitary Commission during the Virginia Campaign of 1862,' by Catharine Prescott Wormeley; 'A Short History of the Secession War,' by Rossiter Johnson, author of 'The History of the War of 1812–15,' etc., with maps and plans; 'Pen and Powder,' by Franc B. Wilkie of the *Chicago Times*; 'Western China,' a Journey to the Great Buddhist Centre of Mount Omei,' by the Rev. Virgil C. Hart, B.D., fellow of the Royal Asiatic Society, with map and 12 full-page illustrations; 'Safe Building,' by Louis de Coppet Berg, Vol. I., illustrated; 'Ancient and Modern Light-Houses,' by Major D. P. Heap, fully illustrated.

Miscellaneous.

'The Life of Lord Stratford de Redcliffe,' by Mr. Stanley Lane-Poole, will shortly be published by Longmans, Green, & Co. (New York). It will give an inside view of that eternal Eastern question for which every English diplomatist must find an answer, as to the riddle of the Sphinx. Much of the matter in these volumes is autobiographical, and there are boyish recollections of

Sheridan, Byron, Fox, Pitt, Gustavus Adolphus, Wellington, and George Canning. At twenty-six our future Lord Stratford helped to found the *Quarterly Review*, and introduced Gifford to Murray. —— Messrs. Fords, Howard, & Hulbert (New York) announce for publication 'The Democratic Party: its History and Influence' (new third edition, revised to date); and 'Tenants of an Old Farm,' an illustrated work on insect-life, by Dr. Henry C. McCook, hitherto sold at $2.50, sold this season at $1.50. —— William R. Jenkins (New York) announces 'Paul Bercy's Works,' for the study of French by the natural method; 'La Langue Française;' 'La Langue Française' (seconde partie); 'Livre des Enfants,' *pour l'étude du Français*, a primer full of illustrations, which serve as object-lessons for the youngest children; 'Le Second Livre des Enfants' (just published), intended for children also. It is full of illustrations, and, like the first book, these form the basis upon which the text is arranged, rendering it attractive in every way to children who have mastered the first book. —— The Burrows Brothers Company (Cleveland, O.) announces 'Christian Science, its Truths and Errors,' by the Rev. H. Melville Tenney; and 'The Pocket Gem Pronouncing Dictionary,' by Lilla M. Tenney, on a new plan. —— The Century Company announces 'Ranch Life and the Hunting-Trail,' by Theodore Roosevelt. —— 'Principles of the Economic Philosophy of Society, Government and Industry,' by Van Buren Denslow, LL.D., has just been published by Cassell & Co. This firm continues its 'National Library,' edited by Prof. Henry Morley, LL.D., a series of weekly volumes of reprints of standard works.

NOTES AND NEWS.

THE New York Academy of Science held its opening meeting Oct. 1. By the election of Professor Fairchild to the chair of natural history at the University of Rochester, the academy has lost one of its most active members, — a loss which will be felt for a long time to come. The publications of the academy have been pushed forward most energetically, and the active editor, Professor Martin, has succeeded in bringing them up to date, their value being thus greatly enhanced. Mr. George F. Kunz sent in an interesting paper on recent mineralogical discoveries, and several members reported on the results of journeys undertaken during last summer's vacation. Dr. H. Carrington Bolton made some interesting remarks on German and Austrian libraries which he had visited in pursuance of bibliographical studies, and dwelt on the defects of the systems of several of these libraries. On the other hand, he described the management of the library of Strassburg as worthy of the highest commendation. The arrangement is thoroughly systematical. Visitors are allowed the greatest possible facilities, and any citizen of Alsace Lorraine applying for books is entitled to have them sent to his house, whether he lives in Strassburg or in some other part of the province. Dr. Brinton gave a brief description of his studies in English collections and libraries, and noted a large collection from Bolivia which is said to contain an unexpectedly large number of species and genera unknown to science. After a brief discussion of the trap rocks of Pennsylvania and New York, Dr. F. Boas gave a sketch of the ethnological results of his journey to British Columbia, during which he visited most of the peoples of that province.

—The committee on publications and lectures, of the Massachusetts Society for promoting Good Citizenship, have issued a circular requesting the clergymen of Massachusetts to prepare and preach, and as far as possible publish, between now and the general election in November, at least one sermon on the duties and responsibilities of American citizenship.

—A study undertaken by W. von Bezold a number of years ago made it probable that thunder-storms have a period corresponding to that of the rotation of the sun. In his inquiry he had used the material collected at the meteorological stations of Bavaria. As, however, an influence of this kind seemed very improbable, he did not publish the results of his researches. Recently Hertz, Wiedemann, Arrhenius, and others have shown that by the influence of radiation the conductivity of the air is changed, and thus a period of the frequency of thunder-storms corresponding to that of the rotation of the sun does not appear improbable. For this reason Von Bezold has taken up his earlier researches, and carefully scrutinized the observations of thunder-storms in Bavaria and Wurtemberg from 1880 to 1887. The *Naturwissenschaftliche Rundschau* reports on a paper on this subject read by Von Bezold before the Berlin Academy of Science. He finds that a period exists; and the proofs he gives are so convincing, that he feels encouraged to pursue this subject more fully.

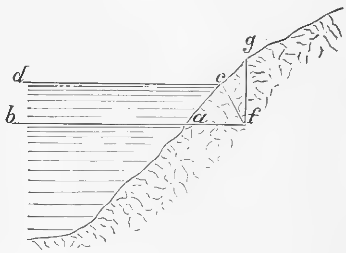
LETTERS TO THE EDITOR.

Floods in the Lower Mississippi.

MAJOR POWELL, in his letter to the New Orleans Chamber of Commerce, suggests as a means of regulating the lower Mississippi the erection of large basins at the head waters of its tributaries in the Rocky Mountains. "The cutting-power of a stream," he says, "increases rapidly with an increase of sedimentary load."

If this be correct, then there must be an increase in either quantity or in velocity by the increasing sedimentary load, those two constituting the working energy of the water, which is: quantity times half the square of the velocity. As to the quantity, there is, in fact, an increase. Draw a cubic foot of water from the river and let it rest. The sediment will settle to the bottom, and is therefore heavier than the amount of water it displaces, as otherwise it would remain in suspension. For this reason a cubic foot of water mixed with sediment is heavier than a cubic foot of clear water.

But how is it that this same sediment was in suspension in the same water when it was in the river? Because the water there had velocity. Velocity has an equivalent in 'head' or water weight



and just as much of this head will be used to carry along the surplus weight of the sediment as is equivalent to this surplus. Diminished head is diminished velocity. Clear water, therefore, will flow quicker (that is, have more working energy) than water mixed with sediment, which will readily be seen when we imagine such an amount of sediment to be added to the water that it would attain the consistency of sirup.

If, now, as Major Powell claims, the product of the two is increased by the increase of sediment, then the gain in weight of the quantity ought to be greater than the loss in velocity. This is not likely, for the reason that the velocity in that product is squared, and every loss in it, therefore, is squared too. It is furthermore not likely, because every gain in weight creates an additional loss in head, part of the latter being used to crush and pulverize the increase of sediment from heavy bowlders in the mountains into fine sand at the mouth of the river. There is only one grand total of power corresponding to a certain head, and every deduction from it is a loss which cannot be made up for again.

The indisputable fact that rivers choked by sediment do more lateral cutting than cleaned rivers, therefore, does not seem to be exactly expressed by attributing this fact to an increase in cutting-power of the water through sediment. If it is, Major Powell should prove it.

Again the letter reads, "The waters of the Missouri come loaded with materials which go on cutting and grinding with constantly increasing energy in their journey to the sea, choking the channel and cutting away the land." I should like to see this sentence more fully explained, as I fail to understand its full meaning.

As a matter of fact, there are other causes besides the action of sediment which increase the amount of river-sediment by bank-

cutting, but the crumbling of banks to a large extent is caused by the dissolving-power of water. Loam, clay, and silt as a rule largely constitute the banks of rivers. Water coming into contact with loam at a point *e* will destroy its cohesion, and carry it away. The water falling from level (*e d*) to *a b* eats into the bank as far as *f*, and the whole body (*f e g*), deprived of its support, will tumble down into the river as soon as it is sufficiently heavy to overcome the cohesion along *g f*; this irrespective of any sediment being mixed with the water, as pure water will destroy the cohesion of those materials in exactly the same way as water loaded with sediment.

The same effect is produced by frost. If bank-material saturated with water freezes up, its cohesion is destroyed. The spring freshets will carry it away.

Another instance of this kind is a bank consisting of layers resting on an inclined clay seam. When for some reason the seam becomes exposed to water, this will moisten its surface and transform it into a slippery mass, thus causing the overlying strata to slide into the river.

Therefore, suppose the head waters of all the tributaries of the Mississippi to furnish an entirely clear supply of water. It enters the river-channel. Immediately it picks up such sediment as its velocity enables it to carry. More sediment is added by the causes presented, — the old condition!

There are other remedies of long-established repute, which, if not by the same constructions, in principle certainly, will be just as practical here as anywhere else.

"The prime end to be sought," so Major Powell correctly puts it, "in order to prevent destructive floods, is to prevent the choking of the channel;" and again, "The real problem is to relieve the river of its excess of sediment." In these views engineers will fully concur. The letter touches upon one of these remedies: "Much of a coarser sediment is left to add to the geological growth of the region, while vast quantities pass on to the sea." The end to be sought, then, is to reverse this condition, and make the vast quantities add to the geological growth of the region. This can be accomplished by fixing, protecting, and in that way solidifying, large deposits which are now in constant migration, and preventing their being transformed again into floating sediment. To this end force the river into a channel, which removes the deposits from the current.

The sediment contributed by the tributaries now is only a trifle as compared with the amount centuries have accumulated in the beds of the Missouri and Mississippi. To make these enormous quantities *terra firma* is more effective than to clean the mountain waters, because the effect will be felt right there where the work is done, and at once.

Another means of making the sediment add to the geological growth of the region is this: Create a strip of 'dead' water on both banks all along the entire extent of the rivers in open and direct connection with the current. There will be a constant exchange of water between the current, where the water is loaded with sediment, and these bodies of standing water; and whatever water from the current gets into this strip will deposit its sediment. Then it returns into the river, is reloaded with detritus, and re-enters the strip of standing water. Thus a destructive agency will be turned into a useful tool, carrying along sediment to add to the geological growth of the region. In course of time this strip will be completely filled, and then the water will not only flow in a concentrated channel, but there will also have been formed a terrace at the foot of the old bank, which protects it. This is the really effective settling-basin, and the thousands of miles of river-banks are the places where they must be constructed, because they do the work right on the spot where it is needed.

JULIUS MEYER, C.E.

Cleveland, O., Sept. 18.

Chalchiuitl: A Note on the Jadeite Discussion.

THE jadeite discussion is evidently not yet terminated. In the *American Anthropologist* for July, 1888, Dr. A. B. Meyer of Dresden maintains his position "that the nephrite (jadeite) question is not an ethnologic problem," the mineral occurring wherever the *artefacts* from it are found; while at the recent meeting of the American Association for the Advancement of Science, August, 1888, Prof. F. W. Putnam of Cambridge reiterated his belief, already expressed in the reports of the Peabody Museum, that the specimens of jadeite from Mexico and Central America were originally brought from Asia.

Jade first became known to modern Europeans by the specimens brought from Mexico, as the origin of the name attests (Spanish, *piedra de ijada*, so called from its supposed virtues in colic, *mal de ijada*), and therefore the references to it in the early writers on Mexico merit special attention. These have been partly collated by E. G. Squier, in his 'Observations on a Collection of Chalchihuitls' (*Annals of the Lyceum of Natural History*, New York, 1869), and later by Professor Fischer in his well-known volume 'Nephrit und Jadeit.' In verifying these quotations, I find that some important authorities have been altogether omitted, and others only partially reported. No direct reference is made to the Codex Mendoza; and Squier omits some of the most important observations of Sahagun, to wit, those referring to the *provenance* of these minerals, — the very point which, in the present stage of the question, we wish light upon. The practical bearing of this point will be readily appreciated when I add that the statement was made at the meeting of the American Association in August, that last winter an expert was sent to Mexico at considerable expense for the sole purpose of discovering the locality of the jadeite, but his search was vain.

The Nahuatl (Mexican) name for jadeite is *chalchiuitl*. This appears to have been applied to any greenish, partially transparent stone capable of receiving a handsome polish. All such were highly esteemed. Specific distinctions were established between such precious minerals by descriptive adjectives, as follows: —

Iztac chalchiuitl, white chalchiuitl; of a fine green, quite transparent, without stripes or stains.

Quetzal chalchiuitl, precious chalchiuitl; white, much transparency, with a slight greenish tinge, somewhat like a jasper.

Tlilayotic, literally, 'of a blackish watery color;' with mingled shades of green and black, partially transparent (chlormelanite?).

Tolteca-iztli, literally 'Toltec knife,' or 'Toltec obsidian;' of a clear, translucent green, and 'very beautiful.'

These are the descriptions of Bernardino de Sahagun (*Historia de la Nueva España*, Lib. XI. cap. 8), probably the source of all other writers upon this subject. He is not very exact as to the localities in which they were found by the natives. The first-mentioned, however, the white chalchiuitl, he states was obtained from quarries in the vicinity of Tecalco. This town, which I do not find on late maps, was in the state of Puebla, and it may be the modern Tecali mentioned by Orozco y Berra in that state (*Geografia de las Lenguas Indijenas de Mejico*, p. 211). It would be worth while searching in that vicinity.

With reference to the last-mentioned variety, the Toltec stone, Sahagun makes a noteworthy remark, not quoted by Squier, which, so far as it goes, is certainly in favor of the view that this valued variety was not from any deposit known to the natives. This beautiful species of chalchiuitl, he says, did at one time exist in this country (New Spain), "and does yet, *as is proved by the pieces obtained from the ancient edifices*." In other words, no deposit was known to the natives of his day, and such fragments as they possessed were exhumed from the ruins of the ancient cities.

The Codex Mendoza is a copy of the tribute-roll of the ancient Mexican Empire (published in LORD KINGSBOROUGH'S *Mexican Antiquities*). It defines the tax from each district, naming the cities. Strings of chalchiuitl are mentioned as part of the tribute from a number of localities, and refer evidently to small rounded pieces used as beads, and obtained from the sands of streams. Only from one district are large pieces of chalchiuitl demanded. These, three in number each year, were required from Tototepec, Chinantlan, and other towns situate in the present state of Oaxaca, and principally in the department of Vilalta (Zoochila). Mühlenpfordt describes this region as mountainous and wild, inhabited by the Mixe Indians and the Chinantecas (*Schilderung der Republik Mejico*, Bd. II. s. 213, 214). This is the spot to which the explorer should penetrate if he would discover the locality of the large pieces of Mexican jadeite.

D. G. BRINTON.

Media, Penn., Sept. 28.

PUBLISHERS' NOTES.

Health Underwear.

Most of the underwear used during the past thirty years has been made of a mixture of cotton and wool. At first the proportion was from 60 to 75 per cent of wool; but this has been gradually reduced, until now the majority of underwear is made entirely of cotton, while much of the so-called mixed underwear does not contain more than 10 per cent of wool. Thus it happens that the public, without being aware of the fact, have been gradually changing from wool to cotton underwear, very much to the detriment of their general health and comfort. A re-action has now set in, and woollen underwear is again coming into general demand. In England and Germany the use of all-wool underwear has increased more than twenty-fold during the past three years. There has also been a considerable increase in this country; but so skilful have manufacturers become in adulterating wool by the mixture of cotton and other substances, that it is difficult for the public to know whom to trust. The time, therefore, seems favorable for a firm — whose name is a guaranty of the quality of their goods — to introduce under a protected trade-mark a line of pure wool and camel's hair underwear of superior quality. The Warner Brothers, 359 Broadway, New York, have associated with them in the manufacture of these goods gentlemen of integrity and large experience, and it will be their aim to merit the same confidence and success in the introduction of Dr. Warner's health underwear that has already so largely attended them in the manufacture of their health corsets.

Type-writing Contest.

The public will remember the series of challenges issued about six months ago by the manufacturers of the Remington, Caligraph, and Hammond writing-machines. Nothing resulting from challenges, the Canadian Shorthand Society of Toronto determined to take the matter up, and arranged a tournament open to any operator on any machine in the world, the terms of which were so absolutely fair that the failure of certain machines to compete must be regarded as an admission of their inferiority. Ten operators (five of whom used the Caligraph, and five the Remington) took part in the contest. Their names and addresses are given below. On general writing, law evidence, and commercial matter, Miss Mae E. Orr won the gold medal for the championship of the world. Mr. F. E. McGurrin won the silver medal in the same class. On the memorized sentence, 'This is a song to fill thee with delight,' Mr. T. W. Osborne won the silver medal. After deductions for errors were made, it was found that Miss Orr had made 4,935 points, — 98.7 words per minute. Mr. McGurrin made 4,756.5 points, — 95.11 words per minute. After deducting errors from the memorized sentence, 'This is a song to fill thee with delight,' it was found that Mr. Osborne of Rochester had written 630.7 words, — 126.14 per minute; Mr. McGurrin wrote 613.3, — 122.66 per minute. The contestants were, Miss Mae E. Orr, New York City, Remington; F. E. McGurrin, Salt Lake City, Utah, Remington; T. W. Osborne, Rochester, N.Y., Caligraph; Miss M. C. Grant, New York City, Remington; G. A. McBride, Ottawa, Ont., Caligraph; Miss Mamie G. McManus, New York City, Caligraph; Mrs. A. J. Henderson, Toronto, Ont., Caligraph; Miss Maud Berry, Toronto, Ont., Remington; T. M. Snyder, Pottsville, Penn., Remington; A. J. Nichols, Youngstown, O., Caligraph.

Coughers to the Front.

"Take time by the forelock" ere that rasping hacky cough of yours carries you where so many consumptives have preceded you. Lose no time, but procure a bottle of the rational remedy for lung and bronchial disease — Scott's Emulsion of Cod Liver Oil with Hypophosphites of Lime and Soda. Rely upon it that it will afford you speedy and efficient aid. Not only is it a pulmonic of surpassing merit, but it compensates for the drain of vitality which is a most formidable accompaniment of lung-disorders. Besides arresting the progress of consumption, bronchitis, and asthma, it infuses unwonted vigor into an enfeebled system, and tends to fill out the hollow places in an angular frame.

Ladies in delicate health will find it a palatable means of adding roundness to a figure robbed of its contour by the inroad of marasmus or other wasting disorders. A scrofulous tendency may be successfully combated with it, and it is a capital thing for feeble children.

Publications received at Editor's Office, Sept. 11–29.

CHANDLER, S. C. Catalogue of Variable Stars. 1888. Lynn, Mass., T. P. Nichols, Pr. 14 p. 4°.

FISHER, G. C. The Essentials of Geography for School Year 1888–89. 3d ed. Boston, N. E. Publ. Co. 74 p. 8°.

HEWES, F. W. Citizen's Atlas of American Politics, 1789–1888. A Series of Colored Maps and Charts. New York, Scribner. 56 p. f°. $2.

JORDAN, D. S. Darwinism. A Brief Account of the Darwinian Theory of the Origin of Species. Chicago, A. B. Gehman & Co. 63 p. 16°. 25 cents.

LOUGHRIDGE, R. H. Report of the Geological and Economic Features of the Jackson's Purchase Region. Frankfort, Geol. Surv. Ky. 357 p. 8°.

MORRIS, C. The Aryan Race: its Origin and its Achievements. Chicago, S. C. Griggs & Co. 347 p. 12° $1.50.

SANBORN, Kate. The Rainbow Calendar for 1889. Boston, Ticknor. 16°. 50 cents.

WORCESTER, J. E. Worcester's Academic Dictionary.

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SCIENCE

FRIDAY, OCTOBER 12, 1888.

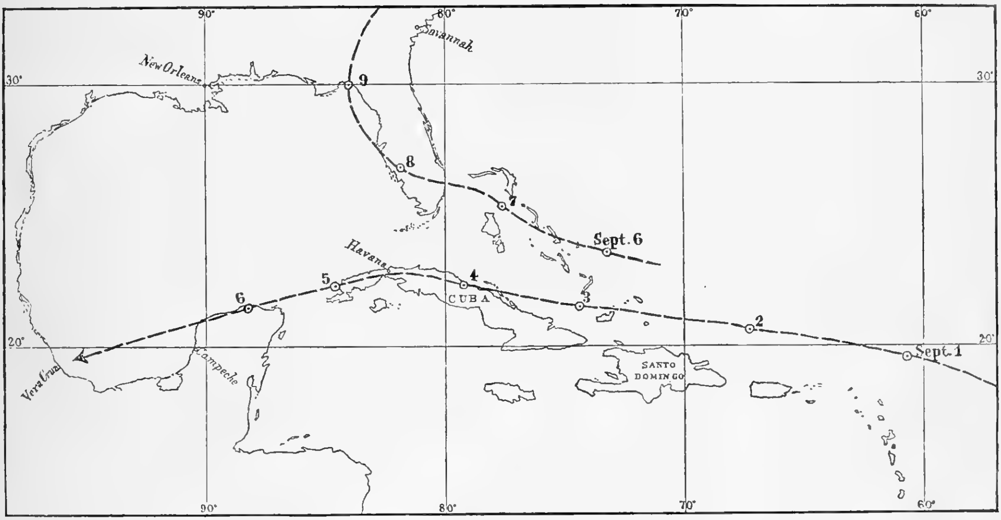
THE SUNDRY CIVIL APPROPRIATION BILL, passed by Congress, has finally been signed by the President, and the grants of money it makes have become available. Among these is one of a hundred thousand dollars, to enable the United States Geological Survey to begin an inquiry in regard to the feasibility of reclaiming the arid lands of the Far West. The sum is not as large as might be profitably used for this purpose, but it will enable a beginning to be made and an organization of the work to be effected. The amount of progress that may be made between now and July, 1889, is much less important than the determination reached by the government to enter upon this great work. This has not been hastily done, or without a full comprehension of the ultimate magnitude of the undertaking, or of the vast possibilities involved in it. The subject was very ably discussed, both in the Senate and House of Representatives, and, what is very remarkable, the debates took place at a time when the political excitement that pervaded both bodies was so great as almost to preclude the consideration of any new question of as great importance as this. It may not be that the amount of land that can be reclaimed from present worthlessness, and converted into rich agricultural lands, will equal in extent the entire area now under cultivation in the United States, as Major Powell has estimated; but, if one-half of this result is realized, the wealth of the country will be increased as it never has been increased before. Homes will be provided for additional millions of industrious people, and the amount of the natural products of the country will be increased almost beyond our present comprehension. It is an appreciation of these facts that causes us to consider the determination of the government to enter upon this great enterprise as the most important public business of the present year.

SCIENTIFIC NEWS IN WASHINGTON.

The Cuban Hurricane. — Tree-Growth on Arid Lands: Forests have Little Effect upon Climate: They do promote Agriculture.

The Cuban Hurricane.

MR. EVERETT HAYDEN of the Hydrographic Office, whose visit to Cuba for the purpose of studying West Indian hurricanes has been mentioned in a previous number of *Science*, reports to the Hydrographic Office that upon his arrival at Havana he placed himself in communication with the Rdo. Padre Benito Viñes, of the Observatory of the Real Colegio de Belen, who has done every thing in his power to facilitate his work. Assisted by this eminent meteorologist, Mr. Hayden immediately began the investigation of the great hurricane that caused such destruction in the island of Cuba from the 3d to the 5th of September. One of the first features, and probably the most remarkable, noticed, was the exceptional and wholly unexpected change of direction in the onward movement of the cyclone on the night of the 4th, from about west by north to the south of west. Such a marked departure from the paths usually followed by these storms in low latitudes at once excited the curiosity both of Padre Viñes and the Hydrographic Office. The cause of this phenomenon seems to have been the presence, not far to the eastward, of another well-defined hurricane, which apparently exerted a marked influence upon the first and more violent one. This influence was shown in a variety of ways, but the details of its operation are still a subject of some uncertainty. According to Viñes, two barometric depressions, starting at about the same time and in the same neighborhood, exert a repellent influence upon one another in the upper currents. The reason assigned is, that the air, after rushing to the centre of the cyclone, rises rapidly, as in a sort of funnel, and when the top is reached (i.e., when, having reached an atmosphere of its own temperature, there is no longer a tendency to rise) the currents flow radially outward towards the circumference of the cyclonic area; and, when two depressions are near enough, these upper currents will meet and repel each



TRACK OF THE CUBAN HURRICANE.

other. Viñes admits, however, that the currents at the surface of the earth tend to make the barometric depressions converge and unite.

In accordance with this theory, the upper currents of these two great barometric depressions met and caused the divergence in the two storms, — one to the south and west, the other to the east and north.

The theory at present favored by the hydrographer, while not denying the possible influence of upper currents, according to that of Viñes, takes into consideration only the surface currents as furnishing sufficient data to explain the phenomenon. Briefly stated, it is to the effect that an energetic area of high barometer was central over the Middle Atlantic States during the occurrence of the two cyclones, the second of which caused the extensive southward rush of air from the high area to impinge against the first low, instead of encircling it. The natural result to be expected from this would be the forcing of the latter to the southward, which actually took place. In addition to this, a third low area is stated to have passed westward over Jamaica on Sept. 3; and this might have tended still more to draw the first low (the great hurricane) towards the south, on the principle that adjacent depressions of the barometer on the earth's surface have a tendency to converge, — a theory favored by Viñes, as noted above.

The results of the labors of the Hydrographic Office promise to be of great interest and value to both meteorologist and mariner, in connection not only with the great storm which has just occurred, but with regard to hurricanes in general.

Trees on Arid Lands.

Major J. W. Powell, director of the United States Geological Survey, has written the following interesting letter to the Kansas City *Times*, thus making a valuable contribution to the discussion of the subjects of forest-growth on arid lands, the effects of hot winds, and the extent to which irrigation may change the agricultural climate of the plains: —

"The plains are treeless because they are arid. There is an opinion widely existing in the popular mind, and springing up in the current literature of the West, which is opposite to this, to the effect that the dryness of the climate is the result of the lack of forests. An argument in favor of tree-planting and forest-culture has often been based on this error. The effect of forests upon rainfall has been investigated by many methods, in many countries, and at many times, and the result of all this investigation shows that the presence or absence of trees influences the general rainfall or amount of precipitation only to a very limited degree. It is, in fact, not certain that their presence does increase rainfall; but it is certain, that, if it does, the increase is so slight as to play but an insignificant part as a climatic factor.

"Yet forests, or abundant trees, exert an influence upon climate in its relations to agriculture. Two ways in which this influence is exerted are worthy of careful consideration.

"First, While it is not probable that forests diminish or increase the total amount of rainfall in any country, yet it appears that forests regulate this rainfall, so that there are fewer fierce storms and more gentle rains. When the rains fall in storms, the water is speedily gathered into streams, and at once passes from the country; but, when they fall in gentle showers, time is given to moisten the soil and invigorate vegetation.

"Second, Forests provide against the speedy evaporation of the water by protecting the lands from the fierce rays of the sun, and more especially by protecting the land from the rapid passage of dry winds, which drink up the water from the soil and growing plants with great avidity.

"It is manifest that the effect of the forests upon the great movements of the atmosphere must be very slight when due regard is given to proportions between cause and effect. Forests can affect only the winds close to the earth by creating a friction at the surface; but the soil, and the smaller plants growing therein, may be greatly sheltered by trees. Though the general climate may be scarcely affected, the agricultural climate may be materially modified.

"The relation of forests to humidity, and of prairies and plains to aridity, should be clearly understood. In middle latitudes, and under average conditions of relative humidity, low, gnarled forests will be produced with about ten or twelve inches of rainfall; that is, in the Rocky Mountain region, and generally on the Great Plains, forests of cedar and pinon can be produced with a little more than ten inches of rain annually. Now, this is a well-established fact. Why, then, are the arid valleys and Great Plains treeless? The answer is, that the fires destroy the trees, and prevent their growth. In a region of great humidity, say, of forty inches or more of rainfall, forests are largely protected from fire by such general humidity. In regions of country having from ten to twenty-five inches of rainfall, all forests are destroyed unless protected by art or topographic position. In regions having between twenty-five and forty inches of rainfall, prairie-lands interspersed with timber-lands will usually be found; that is, in ordinary seasons, trees will be protected from destructive fires by the general humidity, but in excessively dry seasons the trees will be destroyed, now here, now there: so that, by the natural process of tree-propagation, the forests will encroach on the prairies, and through the fires of excessively dry seasons the prairies will encroach on the forests; and so prairie conditions and forest conditions forever contend with each other for the possession of a sub-humid land. In the direction in which aridity increases, prairie conditions will more and more prevail; and, as humidity increases, the forest condition will more and more prevail. In general it may be stated, that, other things being equal, the dryer the climate, the smaller the forests; the wetter the climate, the greater the forests; for, although the rainfall may be sufficient to grow forests, it may not be sufficient to protect them from fires. The Great Plains and the valleys of the Rocky Mountains are all capable of sustaining forests of certain trees adapted to the climatic conditions found therein.

"It is possible, and in due time it will be practicable, for man to clothe the naked lands of the Great Plains and the arid valleys of the West with forests without artificial irrigation. From this must be excepted certain desert-lands west of the lower portions of the Colorado River, where the rainfall is insufficient, and also certain tracts of bad-lands which will always be treeless for reasons that need not here be described.

"The amount of rainfall necessary to produce forests in any given latitude will depend to some extent upon the character and conditions of the soil, some soils needing more rain than others for this purpose; but the soil condition has narrow limits.

"If it be true, as has been asserted above, that the arid plains and valleys may all produce forests without artificial irrigation if protected from fires, how are such forests to be planted, in what manner can they be protected, and how shall the trees adapted to the climate be selected? These are the practical problems to be solved.

"Great areas of uninhabited land cannot be redeemed and protected: the protection must come from men living on the land, and utilizing it for agricultural and pasturage purposes. The way in which this can and will be done may be briefly and crudely sketched as follows: —

"Adown the valleys and across the plains flow many streams of water — brooks, creeks, and rivers — that have their sources in the mountains by which the arid lands are dissected; and all of these streams can be utilized to irrigate the dry and parched lands that now present the desolation of deserts. By their use many tracts of land scattered far and wide throughout the whole country may be brought under cultivation, and covered with growing fields and luxuriant groves. In this manner populous and prosperous settlements may be distributed throughout that land of drying winds and scorching suns. When industrious and thrifty people once get a foothold in this manner, they plant orchards and vineyards, and surround their farms and fields with trees, and plant them by the roadside, and every man devotes a part of his farm to timber-culture, and the naked lands are speedily covered with a rich vegetation. A generation ago the prairie region east of the Missouri River was so destitute of forests that large districts were supposed to be practically uninhabitable; but since that time it has been covered with orchards, vineyards, and groves, and now, from the lands that were once so naked, millions of trees spread their branches to the breezes. In the same manner, by means of artificial irrigation, great numbers of tracts of land will be cultivated throughout the

arid country, and diversified groves will be developed. But not all the arid lands can be redeemed, as the water of all the living streams is inadequate to the task; but the intervening land will be utilized for pasturage purposes, and will be protected by the people from fire, and groves will be planted, and the face of the country not under cultivation will be forested.

"In the region practically uninhabited the water now flows from the mountains to the sea; but, when the streams are utilized in irrigation, the water will be evaporated, and the humidity of the climate will be increased thereby, and dry winds will no longer desiccate the soil and shrivel the vegetation. As the general humidity is increased, the moister air, as it drifts eastward in great atmospheric currents, will discharge more copious rains, and the humid region will extend farther westward, and the arid region will correspondingly shrink in its proportions. Irrigation will increase the humidity of the climate, and increase protection from fires to the non-irrigated lands; and, as the lands gain more and more water from the heavens by rains, they will need less and less water from canals and reservoirs. When all the water of the arid country is ultimately appropriated for irrigation by using all the streams through the season of irrigation, and by storing the surplus that flows through the non growing season, and by collecting in reservoirs the storm-waters of the streamless valleys, the general humidity of the atmosphere in the arid region will be increased, and hence the rains will be increased, and a smaller amount of artificial irrigation will be needed. By all of these means a large share of the arid lands will be redeemed. But all will not be redeemed: there will still be extensive areas of pasturage-lands not under the plough, for all that man may do will be insufficient to radically change the climate. The non-irrigated lands can be greatly improved by extensive tree-planting; but as these trees are to be supported by the general rainfall, which is scant, it will be necessary to select trees adapted to arid conditions, and this will require extensive experimentation. The wide distribution of the cedar, and of the pinon or nut-pine, throughout the country under consideration, points out the fact that these two trees may be widely used; but there are many others on the Pacific coast which perhaps will be more valuable; and it will probably be found that there are many trees in the arid lands of the eastern hemisphere which can be introduced with advantage. But this tree-planting is a question of a somewhat remote future. At present the trees planted in the arid region will depend for their existence and vigorous growth upon irrigation, and the experiments demanded at the present time must be with such trees.

"The great currents of air which now traverse the plains are impelled by agencies that produce the general circulation of the atmosphere throughout the globe, modified by the general configuration of the plains in its relation to the mountains of the West and the low humid lands of the East. These general conditions cannot be modified by man; and the storms will come and the winds will blow for ages as they now do, unchanged by the puny efforts of mankind; and yet the agricultural conditions of the country may be greatly modified and improved by the efforts of man. Man cannot change the great laws of nature; but he can take advantage of them, and use them for his purposes.

"There is a theory held by some persons in the West that rainfall is largely dependent upon the electrical conditions of the atmosphere, and that these conditions are modified by the various changes wrought by the hand of man in the settlement of the Great Plains. As this appeal is to some occult agency, it becomes quite popular to those who love to revel in the mysteries of nature. Of course, it is never explained. It is a case where cause and effect are confounded. Atmospheric electricity is the result of certain conditions and movements in the atmosphere. To explain atmospheric changes by attributing them to electricity is like explaining the origin of the fire by the light it produces, or like explaining the explosion of the powder in the cannon by attributing it to the roar which may be heard in the distance. The electricity in the air is related to atmospheric changes as effect is related to cause.

"In conclusion let it be said, first, that a large body of the arid lands can be redeemed by irrigation, and that the agriculture resulting therefrom will be in the future, as it has ever been in the past, the highest condition of agriculture, for the agriculture which is dependent upon rains is subject to storms on the one hand, and to droughts upon the other; but, when the water-supply is properly controlled by the arts of man, the soil is made to yield its most abundant returns; second, that, under the culture and protection of man, vineyards, orchards, and groves can be established over vast areas, where, under the control of nature, only deserts are found; third, the siroccos of the Great Plains cannot be tamed, but men may protect their homes, their gardens, and their fields from devastation by them; fourth, the lightnings of heaven cannot be employed to bring rain upon the plains, but electricity may be used to illumine the cities and towns and hamlets that must ultimately spring up over all that land."

HEALTH MATTERS.

Recovery from Lightning-Shock.

Dr. J. B. Paige read before the Medico-Chirurgical Society of Montreal an account of a case of lightning-shock which resulted in recovery.

The accident occurred in Prescott, Mass., during a terrific thunder-storm, July 29, 1887, about five o'clock P.M.

Lightning struck the house, to all appearances the chimney of the upright part first. At the roof the current divided into three parts, one following the chimney down to the floor of the second story, then passed along a stove-pipe out of the chimney, and partly to a nail in the floor by the legs of the stove, and thence by the timbers to the earth. A second subdivision of the current followed a rafter on the north side of the roof, after leaving which it could not be traced. This rafter was completely torn from its place. A third current passed down a rafter on the south side of the roof. At the lower end it divided again, one portion following the finish of the roof, passed along the other side of the L to the opposite corner, followed the track of a rolling-door, and reached the earth by the corner post of the house. The other part coursed along the studding of the house, near the window, and passed to the earth. Attached by a screw to the upper casing of the window was a large iron hook on which was suspended, by a brass chain, a bird-cage. One part of the current, going by this chain to the bird-cage, left it at one corner, entered the body of the subject of the accident, and left the room by a nail in the floor.

That the electrical influence in this quarter was intense, is proved by the fact that the links of the chain in some places were nearly melted apart, while the solder at the corner of the cage, where the fluid left, was completely melted. Again, the nail by which it passed through the floor was considerably roughened. It appeared as if it had been partially melted at a high temperature.

The patient was thrown from the chair in which she was sitting, directly across another chair, a distance of two or three feet. She was taken out to the piazza immediately, and her condition was found to be as follows: completely unconscious; motionless; muscles relaxed; left eye closed, right open; face purple; pulse at wrist imperceptible; neither heart-sounds nor respiratory murmur to be heard.

Later, an examination showed the course of the electric current to be as follows: it struck the head above the left eye, midway between the eyebrow and hair, which was apparently the part nearest the corner of the bird-cage; passed along in front of the ear, then to the central line of the thorax, descending by the stocking-supporter, which was attached to the corsets; thence to the top of the stockings, leaving marks upon both limbs, but more especially upon the left, on the back of which, just above the knee-joint, was a burn about the size of one's hand. It had the appearance of an ordinary burn, and was only superficial. No trace of the current could be detected again until the foot was reached, from which it passed off by the joint of the great toe, tearing a place about two inches in diameter in the stocking and slipper, but not leaving the slightest mark upon the skin. With the exception of the burned spot on the posterior part of the left leg and one or two small burns on the body and the right leg, hyperæmic lines alone marked the course of the electricity in its passage over the body.

After removal of the patient to the piazza, the clothes about the neck and chest were loosened, and artificial respiration commenced.

In from three to five minutes the first sign of life appeared in the flexion of the right leg. The dark color disappeared from the face, and the pulse could be felt at the wrist. It was then weak, rapid, and irregular. The treatment was kept up for ten or fifteen minutes, until the body began to feel cold, when the woman was removed to the house, and placed upon a bed. The moving caused a disturbance of the circulation, as was shown by the pulse, which became very faint and fluttering. In order to encourage the circulation, hot fomentations were applied to the chest, and as soon as they became cold were replaced by fresh ones.

Soon a new train of symptoms set in. There was difficult respiration. The mucus and saliva, which were very abundant, had gravitated back, and could not be swallowed because of complete paralysis of the pharynx, etc. There was, in fact, paralysis of almost all the muscles of the uppermost parts of the body, including the arms. The symptoms were those exhibited by an animal when being asphyxiated: violent muscular contraction, difficult and forced respiration, etc. To remove the saliva and mucus, which caused the obstruction, the head and trunk were lowered. Handkerchiefs were also used. These were placed over the finger and passed back as far as possible into the throat, and in this way large quantities of the saliva and mucus were gotten away.

From one-half to three-quarters of an hour after the accident, consciousness began to return, and the muscles of the arm to regain strength. Sight was restored to the right eye, although it could not be moved. Though the subject could hear, she could not speak. This was shown by the fact, that, when asked to press the hand if she felt better, she responded. About this time paralysis began to disappear gradually from the tongue. Improvement continued: brief intervals of sleep were enjoyed through the night, and there was absence of any considerable pain.

In addition to the paralysis, the left eye was seriously affected. In discussing the case, Dr. Wesley Mills asked whether the patient would have recovered without the assistance rendered just after the accident. Considering that respiration was suspended, that the circulation, even with artificial respiration, was so feeble that the temperature fell, that consciousness did not return for so long, it does not seem reasonable to believe in the possibility of spontaneous recovery. But the case does seem to teach, in the clearest way, the importance of using such means as those employed in this instance promptly and perseveringly.

DEATH OF PROFESSOR PROCTOR. — That the disease from which the late Prof. Richard A. Proctor died was actually yellow-fever has been questioned by some of his friends. In order to determine the question, a post-mortem examination was made at the hospital on North Brother Island by Drs. T. Mitchell Prudden and H. M. Biggs, pathologists to the Board of Health, in the presence of Dr. Cyrus Edson chief inspector of contagious diseases, Health Commissioner Joseph D. Bryant, and others. The preliminary report of the examination, presented to the president of the Board of Health, is as follows: "Decomposition was so far advanced that it was impossible to arrive at a definite conclusion as to the cause of death. The organs presented no evidence whatever of pernicious remittent-fever, or other form of malarial disease, such as, even in the condition of decomposition presented by the body, would ordinarily be apparent. The only positive change due to disease which could be made out was in the kidneys, which showed the appearances of old, though not advanced disease. The alterations produced in the body by yellow-fever are usually of such a character as to be nearly or completely obliterated by advanced decomposition. We are therefore only able to say in this connection that there was no other evident cause of death, and nothing which could be incompatible with that disease. The final conclusion as to the cause of death must therefore, in our opinion, be largely based upon the clinical history."

PHYSICAL EXERCISE AMONG CELESTIALS. —A correspondent of the Shanghai North China *Herald* says that to the average Celestial it is a matter of indifference how long he remains in one position. He will write all day like an automaton, he will work from morn to eve without any variation and apparently without any consciousness of the monotony. The Chinese school-children will undergo an amount of confinement, unrelieved by recesses or changes of work, which would drive a western pupil to the verge of insanity. Even Chinese infants are said to remain as impassive as 'mud gods.' To the Chinese, exercise appears to be superfluous, and they can sleep anywhere. With a brick for a pillow, the 'heathen Chinee' can lie down on his bed of stalks, or mud bricks, or rattan, and sleep the sleep of the just, with no reference to the rest of creation. He does not want a darkened room, nor does he require others to be still. The 'infant crying in the night' may continue to cry, for all he cares: it does not disturb him. In the case of most working-people, and also in that of many others, position in sleep is of no sort of consequence.

POISONOUS EFFECT OF PETROLEUM. — In a letter to the *Medical News*, Dr. W. H. Sharp of Volcano, W.Va., discusses the poisonous effects of petroleum. For nineteen years he has practised medicine in an oil town, surrounded by oil-wells, and in daily contact with laborers connected with the oil-industry. He says that in considering the effects of petroleum it is necessary to know clearly which kind of oil is indicated, as there are different grades of natural oil, which must have different effects as they are richer or poorer in the lighter products, as gasoline, benzene, naphtha, and carbon-oil. The heavier natural oils, of specific gravities ranging from 26° B. to 35° B., such as are produced in West Virginia at this point, in Pennsylvania at Franklin, and at a few other points, are very different in composition from the lighter petroleum oils which range from 35° B. to 50° B., such as are so largely produced in Pennsylvania and Ohio, and are used for refining for illuminating purposes. The former are almost devoid of the gasoline, naphtha, and benzene found in the latter, and do not make a satisfactory carbon-oil. Where this heavy oil is produced, there is found less gas than accompanies the light oils. The worker in these heavy natural oils runs no risk at any time from the inhalation of gas, even in the tank-sheds where the oil is stored, and the engineers at the pumping-stations of the transportation companies are exposed to no dangers from inhalation of gas. In all the light-oil districts serious accidents are quite frequent from the inhalation of gas. It is the practice to have the receiving-tanks at the wells closely housed with wooden sheds, at the roofs of which are ventilators for the escape of gas. This past spring an oil-man who had gone to North Baltimore, O., for work, was suffocated in one of these tank-sheds while making a run of oil; viz., running the oil from the receiving-tank to the transportation or pipe-line company's tanks. It is said that the men employed in this work by the transportation companies become somewhat accustomed to this gas, and can then remain longer exposed to it before feeling its effects. Oil-well drillers affirm that the sense of suffocation comes on very suddenly. When the gas is very plenty around drilling-wells, and if there be any delay in getting pure air, suffocation ensues. In the section around Volcano, even when drilling in light-oil territory, there is little danger from this, as the derricks are seldom tightly housed, as is the practice in other regions. Heavy lubricating-oils applied locally are not irritating: they are as bland to the skin as the best petroleum jelly or ointment. They have had a well-deserved reputation as soothing applications to burns and wounds: the heavier the oil, the better it is suited for this purpose. These oils do not irritate any inflamed surface, but relieve the pain as well as does the *linimentum calcis*, or white-lead dressing. The only disadvantages in its use are, that the cloths become stiff from drying, and the application is a dirty one, penetrating the bedding, etc., if applied freely. A light oil 40° to 50° gravity would probably prove irritating from the presence of benzene, etc. Internally these heavy natural oils have been used in pulmonary troubles, viz., bronchitis and phthisis; persons taking them in doses of from 1 to 4 f ʒ several times a day. Dr. Sharp has never known or heard of any ill effects from their administration. He has made a careful search in the *American Journal of the Medical Sciences* since 1869, and in other journals, and finds only two cases of poisoning by petroleum recorded; viz., in the April number of the *American Journal of the Medical Sciences* for 1873, and in the *Medical Record*, Sept. 26, 1885. From these two cases petroleum would not seem to be very poisonous, and to be chiefly eliminated by the skin and kidneys, especially the latter, unchanged by transudation. That it is the lighter oils in the crude petroleum which produce the intoxicating effects, and that the *acne* seen in workmen is due to something used in the process of refin-

ing, are highly probable: certainly they do not arise from contact with the natural oils of the heavier gravities, viz., 26° B. to 35° B.

THE VALUE OF VACCINATION. — Zürich, according to *The Lancet*, is beginning to suffer from the effects of neglect of vaccination. Until 1883 a compulsory vaccination law was in force, but in that year it was repealed; the success of the anti-vaccinationists depending, it is said, upon the fact that not a single case of small-pox occurred in 1882. But in 1883, in every 1,000 deaths, 2 were caused by small-pox; in 1884 there were 3 in every 1,000; in 1885, 17; and in the first quarter of 1886 there were 85 deaths. While Europe is exhibiting folly by showing in some localities opposition to vaccination, Japan is deriving benefits from the recognition of its value. Nagasaki possesses a governor, named Kusaka, who is bent upon ridding the town of the diseases which formerly infested it. By means of a system of compulsory vaccination, rigorously enforced by the governor, small-pox, long a familiar scourge in the old town, has been practically stamped out. Germany, too, is showing the effects of revaccination, and hitherto the freedom of German towns from small-pox has contrasted in a marked degree with a larger prevalence of this disease in other European towns where revaccination is not enforced. Probably the outcome of the experience of the present generation will be the enforcement of revaccination in the majority of civilized countries.

ELECTRICAL SCIENCE.

Is the Velocity of Light in an Electrolytic Fluid influenced by an Electric Current in the Direction of Propagation?

THE following description of Lord Rayleigh's experiment on this subject is given in Professor Lodge's sketch of the papers read before the last meeting of the British Association: —

It is well known, that, when an electric current flows through an electrolyte, an actual transfer of matter accompanies it, — two opposite transfers, in fact, as evidenced by the continuous appearance and escape of the travellers, one at each electrode. It is also known by a refined experiment of Fizeau, confirmed by Michelson, that, when a beam of light travels down a stream of moving matter, its velocity is slightly increased; whereas, if light travels against a stream of matter, it is slightly retarded. These things being so, it may be held as probable, that, whenever the two ions taking part in an electrolytic current differ in momentum, a slight effect may be exerted on the velocity of light travelling with or against the current; but then, according to the calculations of Kohlrausch, confirmed by some experiments of Professor Lodge, the speed of the electrolytic ions is extremely small, the quickest being thirty microns per second, or about four inches an hour, for an applied slope of potential of one volt per centimetre.

The effect of such a creep as this was not what Lord Rayleigh looked for. It was quite within the range of possibility that the existence of an electric current in an electrolyte should so disturb the ether inside it as to produce quite a notable change in its index of refraction. Were such an effect discovered, it would be a distinctly new fact, not taken into account, or even rendered probable, by existing theories; and it is very well to have the question experimentally examined, and to a certain extent set at rest.

The method adopted was a beautiful interference arrangement of Michelson, whereby a beam of light is split up into two halves, which are sent along a certain route, or circular tour, and are then recombined into one at the point whence they originally split off, and are examined by a magnifying eye-piece. The result is a set of interference-bands more or less well defined. Tubes containing dilute sulphuric acid supplied with an electric current are then placed along the route taken by the two half-beams of light, so that one half the beam will be helped and the other half hindered by the current, if it produce any effect at all. The thing looked for is to see if the interference-fringes shift along microscopically when the current is supplied, stopped, or reversed. The result is negative; and, by considering carefully how much of an effect could have been certainly perceived if it had existed, the definite statement is made, that a current of intensity of one ampère per square centimetre through dilute sulphuric acid does not affect the velocity of light in its own direction by so much as one part in thirteen million, or by fifteen metres per second.

THE TUDOR ACCUMULATOR. — Some details of tests of the Tudor accumulator have already been given in this journal, but the following data are more complete than any hitherto obtainable. In the Tudor accumulators a crystalline coating of peroxide of lead is formed on the positive plates by a process that lasts two or three months, while the negatives are produced by the application of red lead, as in the ordinary types. Two of these cells, said to have been in use from November, 1881, to December, 1887, were tested by Prof. W. Kohlrausch. They were submitted to thirty-four charges and thirty-four discharges, there being a mean interval between the two of fifteen hours. The weight of the plates in a cell is 13.6 kilograms; the volume of the liquid, 3.4 litres; there are four positive plates with a surface of 12 square decimetres; the normal charging current is 5 ampères; discharge current, 6.5 ampères. The following figures give some results of the tests: —

	Charge.	Discharge.
Intensity of current	5.00	6.50
Difference of potential at terminals	2.15	1.88
Mean capacity	50.80	47.70 ampère hours.
	109.00	90.00 watt hours.
Mean duration	10.16	7.35 hours.
Efficiency	94 % in ampère hours.	
	82.40 in watt hours.	

The following figures are also of value in comparing with other types of secondary batteries: —

	Charged.	Discharged.
Density of liquid	1.147	1.115
Internal resistance	0.015	0.020
Current density per square decimetre	.417	.542
Capacity in ampère hours per kilogram of plate	3.500	-
Capacity in watt hours per kilogram of plate	6.600	-

Let us compare the capacity and discharge-rate of this cell with a Julien cell, the weight of the plates being about the same. The figures given for the Julien cell are approximate.

	Tudor.	Julien.
Useful capacity (watt)	90.0	190
Discharge-rate	6.5	20
Efficiency	82.4	70 (about)

The Tudor accumulator is, then, inferior to the well-known 'grid type' in storage-capacity and discharge-rate, — two very important factors. Its greater efficiency is partly due to the low discharge-rate. As far as length of life and ability to resist rough usage go, the Tudor cell is, if we are to believe the report, superior. The cells under test were said to have been in use for six years, and were in good condition. During the experiments they were several times allowed to become completely discharged — an operation that severely injures an ordinary cell — without apparent ill effect; and once the cells were completely reversed, and then charged again in the right direction, still without apparent injury. In considering the value of new types of accumulators, the main points to be considered are, leaving out questions of first cost, discharge-rate, length of life, storage-capacity, and ability to resist rough usage. In length of life and ability to resist rough usage the Tudor batteries seem to give better results than any for which reliable figures have been given. In storage-capacity and discharge-rate they are distinctly inferior to the ordinary type; and it is these defects, especially the latter, that render them unfit for traction-work, and for most cases of central-station lighting.

THE EMPLOYMENT OF MICA IN CONDENSERS. — Most of the condensers supplied for electrical measurements are made of sheets of tinfoil, separated by thin layers of mica. It is important to know whether the capacity of a condenser made in this way is constant, or whether it varies with the duration and amount of the charge. M. Klemencic has studied the specific inductive capacity of mica, on which the capacity of the condenser depends. He used two sheets of the mineral .5 of a millimetre and .1 of a millimetre in thickness respectively, making two condensers with them, and comparing their capacity with that of a standard air-condenser, using different periods of charge and discharge, and different electromotive forces. The following table gives the results obtained: —

Electro-motive Force of Charge	Sheet of .5 of a Millimetre.		Sheet of .1 of a Millimetre.	
	t=.00026 sec.	t=20 sec.	t=.00026 sec.	t=20 sec.
1 Daniell	6.62	6.89	6.54	6.99
2 "	6.72	—	6.48	—
4 "	6.66	—	6.46	—
6 "	6.68	6.94	6.45	7.00
1 "	6.67	—	6.46	—
1 "	6.66	—	6.45	—

M. Klemencic also studied a condenser of .15 microfarads capacity formed of 19 sheets of mica of 15 centimetres square, with tinfoil between them. In the following table the figures under t_1 represent the time of charge; under t_2, the period between charge and discharge. In one case 12 Bunsen cells were used in charging; in the other, 1 Daniell.

t_1	12 Bunsen t_2		1 Daniell t_2		
	.007 s.	2 s.	007 s.	2 s.	60 s.
.002	3.494	3.478	3.572	3.543	3.461
.300	3.501	3.486	3.600	3.577	3.495
1.200	3.532	3.530	3.620	3.611	3.575
60.000	3.538	3.532	3.637	-	3.584

The numbers in the different columns are the ratios of the capacity of a standard air-condenser to those of the mica-condenser. If we take the values for $t_1 = .3$ s., and $t_2 = 60$ s., we will have about the actual case in practice, and none of the other values differ from it by more than one per cent: so, if M. Klemencic's results are correct, we can depend upon mica-condensers within that limit.

MENTAL SCIENCE.

Association by Contrast.

M. PAULHAN (*Revue Scientifique*, Sept. 1) calls attention to the widespread application of the law of contrast. This law he formulates as saying that every psychic state tends to be accompanied (simultaneous contrast) or followed (successive contrast) by an opposite state. An excellent instance of it in sensation is that of complementary colors; but it is equally applicable to feelings, thoughts, and beliefs. A physiological homologue is shown in the fact that a contraction of a muscle is not accomplished without the simultaneous innervation of its antagonistic muscle. The flexors are always opposing the extensors, and *vice versa*, and it is a properly adjusted opposition of the two that results in an accurately co-ordinated movement. In the higher psychic states the state must usually be long, and maintained with some difficulty, to have the contrast appear. In all hesitation we see a balancing of opposites, each argument *pro* at once calling up a parallel argument *contra*. The introduction of a new set of ideas at once arouses an opposite train of familiar thoughts. Objections that at first seem trivial and not worthy of attention gather force by brooding over them. Again: all knowledge is relative, and epithets must be compared with their opposites: 'little' suggests 'big,' and 'big' is only relative to the 'little.' People differ very much in the readiness with which they take suggestions, in the difficulty with which the opposite train of thoughts arises. In hypnotism this 'contrasting' power is at a minimum, and very rarely does a concept suggest its opposite. In normal natures combativeness plays very variously important *rôles*. Morbid instances of this mode of mental action are also to be found. Griesinger records a case of a lady constantly saying just the opposite of her intentions. Some insane patients personify these contrast associations into internal voices controlled by rebellious spirits constantly suggesting the opposite of what they ought to do. Kussmaul describes a state as dysphrasia in which the emotion is opposed to the words expressing it, and so on. All this illustrates the wide scope of this association by contraries, which same trait we recognize in its extreme moral-intellectual side as contrariness.

The principle of successive association finds an equally broad field of application. Its elusory illustrations are particularly good in sight (complementary colors, after-images), but are also present in taste (as when any thing tastes sour after eating sweets) and in almost all types of sensations. But we can find the same law in emotional states. Depression is the recognized after-effect of too jovial dissipation. In hypnotism there seems to be a definite alternation from one emotion to its opposite, that suggestion, or, according to some, the stimulation of a magnet, can excite. In fact, all such phenomena can be regarded as governed by the universal law of rhythm, one state recurring at regular intervals, filled in with states of an opposite character. Sleeping and waking, inspiration and expiration, illustrate the physiological aspect of the law. Darwin brings the sentiment of remorse following upon cruelty under the same law.

Under marked conditions such alternations of emotion are extremely frequent, and lie at the root of the hysterical diathesis. Periodic insanity showing exaltation followed by depression, the assumption of unworthy habits by most respectable patients, passionate outbreaks in peaceably disposed patients, — all these are not infrequent. Cases of dual consciousness are perhaps only intensified instances of such successive contrasts. In incipient insanity the dearest relations are often the objects of most intense antipathy.

Such phenomena of successive contrast as depend for their effect upon the presence of an interval since the experience was last made, are equally varied, and equally numerous. Eating after long hunger, re-union after long separation, success after long struggle, enjoyment after much care, — all these give especially great pleasure. Pleasures too often partaken of pale, and need the spice of contrast for their relish. Again: a privation always suggests a longing. When we are deprived of a convenience, we feel the need of it most. When circumstances prevent the realization of our wishes, the displeasure is at a maximum: witness homesickness. The fatigue of one set of emotions brings on the opposite set, perhaps; when continued too long, any state tends to lessen in intensity. Sometimes the feelings flit between sorrow and joy, and we have a curious mixture of the two, — a selfish comfort and a trying sympathy. All such considerations suggest, however sketchily, the existence of an underlying psychophysic law that makes the union of opposite psychic states especially significant.

HYPNOTISM AND CRIME. — Hypnotism as an aid to crime has been variously discussed in France from both the medical and the legal side, with the general conclusion that legislation is needed to cover the most palpable employment of it. The fact that a hypnotized subject can take and execute a criminal suggestion made by another, and yet be really innocent of any immoral intent, is beyond all doubt; and this fact has led observers to the conclusion that the blame must rest upon the giver of the suggestion. An additional precaution which the true originator of the crime might take would be to give a suggestion forbidding the subject to reveal to any one the name of the suggester or the fact of the suggestion. On the contrary, he was to say and feel that the act was committed of his own accord. This complicated the legal aspect of the question very seriously; but further experiments have shown that the instigator of the crime would not be so entirely safe, after all. M.

Jules Liégeois, who has studied most carefully the legal aspects of hypnotism, suggested to a lady subject that she take a pistol and shoot a certain Mr. O. She acted out the suggestion perfectly, not knowing that the load was a blank cartridge. When again hypnotized, she admitted the crime and defended her action. Another gentleman now gave her the suggestions (1) that when the instigator of the crime enters the room she should go to sleep for two minutes; (2) on awakening, she should fix her eyes upon the man constantly until allowed to desist; (3) she should then stand in front of him and attempt to conceal him. When M. Liégeois entered the room, she fell asleep, and did all that was asked of her, thus revealing the instigator, though told by him not to do so. Professor Bernheim induced a subject to steal, and forbade him to mention that he had been told to do it. The patient said he stole because the idea occurred to him, but, when told to go up to the true criminal and say, "Please sing me the Marseillaise," he did so. It seems, then, that the subject will do nothing that he has been categorically forbidden to do, but that he will succumb to an indirect mode of revealing the true instigator of the crime. This certainly aids the courts; but it is a question how far it will be of service when the true criminal is not present, and whether additional suggestions in the first instance will not considerably interfere with the reliability of later testimony. Its further development will be watched with great interest by all students of the scientific aspects of mental phenomena.

PSYCHIC EFFECTS OF HASHEESH. — Mr. A. M. Fielde has recently recounted his experiences under the influence of hasheesh. He smoked the hasheesh until he felt a profound sense of well-being, and then put the pipe aside. After a few minutes he seemed to become two persons: he was conscious of his real self reclining on a lounge, and of why he was there; his double was in a vast building made of gold and marbles, splendidly brilliant, and beautiful beyond all description. He felt an extreme gratification, and believed himself in heaven. This double personality suddenly vanished, but re-appeared in a few minutes. His real self was undergoing rhythmical spasms throughout his body: the double was a marvellous instrument, producing sounds of exquisite sweetness and perfect rhythm. Then sleep ensued, and all ended. Upon another occasion sleep and waking came and went so rapidly that they seemed to be confused. His double seemed to be a sea, bright, and tossing as the wind blew; then a continent. Again he smoked a double dose, and sat at his table, pencil in hand, to record the effects. This time he lost all conception of time. He arose to open a door: this seemed to take a million years. He went to pacify an angry dog, and endless ages seemed to have gone on his return. Conceptions of space retained their normal character. He felt an unusual fulness of mental impressions, — enough to fill volumes. He understood clarivoyance, hypnotism, and all else. He was not one man or two, but several men living at the same time in different places, with different occupations. He could not write one word without hurrying to the next, his thoughts flowing with enormous rapidity. The few words he did write meant nothing. This experience admirably illustrates the close relationship between states of real insanity and transitory affections induced by psychic poisons.

BOOK-REVIEWS.

Elementary Political Economy. By EDWIN CANNAN. London, Henry Frowde. 16°. (New York, Macmillan, 25 cents.)

THIS little book is designed to set forth the rudimentary truths of political economy, and in some respects it is quite successful. Though containing only a hundred and fifty pages, it touches most of the fundamental facts and doctrines of the science, and explains some of them as clearly as could be expected in so small a compass. It is divided into three parts: the first treating of production; the second, of exchange and distribution; and the third, of the economic functions of the State. Mr. Cannan, however, seldom uses the familiar terms 'production' and 'distribution,' but employs roundabout expressions instead, — a practice that seems to us the reverse of commendable. He also avoids the term 'wealth,' using the phrase 'useful material objects' instead, and this phrase is repeated through his pages almost *ad nauseam.* Another fault in a work meant for beginners is the obscurity of the style in certain parts, as, for instance, in the sections on profits and wages; though in other parts the style is quite clear. Some important topics, too, such as the law of agricultural rent, are overlooked. The book seems to have been rather hastily prepared, and, in spite of some excellent qualities, is not what an elementary treatise on economics ought to be.

Report of the Geological Survey of Ohio. Vol. VI. Economic Geology. Columbus, State. 8°.

THE sixth annual report of the State Geological Survey of Ohio appeared early in the present year. The material for publication was partially ready in 1885, entirely so in 1886, and should have been published in 1887. This furnishes another illustration of the many difficulties with which science has to contend in bringing the results of its work before the public, when dependent upon legislative action.

Valuable matter accumulates, and remains in the hands of the publisher for long periods, which, if presented to the public at once, would be of great assistance to workers in other fields, and oftentimes prevent time and money being spent on questions which had already been solved.

The present volume is devoted entirely to economic geology, and principally to the subjects of oil and natural gas, nearly six hundred pages out of about eight hundred being taken up with descriptions of their modes of occurrence, their geological relations, and the methods of obtaining and handling them. Much of the matter has already been made public in a preliminary abstract by the State geologist and various papers in scientific journals.

The whole work teems with facts which are not only of interest to the scientist, but of great advantage to the practical workers in coal and gas as well.

After a general review of the geology of the State, in which its formations are shown to extend from the Trenton limestone as a base to the Upper Barren Coal-Measures, the more prominent theories of the origin of gas and oil are discussed, and compared with the phenomena observed in the Ohio fields. Discarding entirely the theory of chemical origin, it is maintained that petroleum is derived from organic matter, more largely vegetable than animal, but both; that it is derived from both shales and limestones; and that in the Ohio fields it has been produced at normal rock temperatures, and not by distillation. "The stock of petroleum in the rocks is already practically complete," is the reply to the question, so often asked, "Is the supply inexhaustible?"

Till 1884 the Trenton limestone was not considered a productive oil-bearing horizon. The discoveries of that year, however, in western Ohio, at once gave it a high rank. Beginning with the Findlay field, where the discovery was first made, and where, out of eighteen wells complete to April, 1886, but one had proved non-productive, the work extended through other portions of the State, the areas next in order of importance being the Lima and Bowling Green fields. The quality of the gas compares more than favorably with that of Pennsylvania; it furnishes a very valuable fuel; and its discovery has greatly increased the development of manufacturing interests in that section, while the growth of population has been correspondingly rapid.

In the eastern portion of the State, the oil-producing rock is the Berea grit, a subdivision of the sub-carboniferous. Its structural features, however, are not such as to favor the accumulation of paying quantities of gas or petroleum; and, although a very large number of wells have been sunk, with few exceptions they are entire failures.

In the central counties and those bodering Lake Erie to the north-east, the Ohio shale furnishes a small but very persistent flow of gas, which has become of considerable economic importance. But while this shale is also rich in oil, it is not obtainable in sufficient quantities to make it valuable.

A separate chapter is devoted to a description of the Macksburg oil-field, one of the earliest to be worked, and still very productive. The productive area is confined to a small anticlinal in the Berea grit, outside of which all wells have been complete failures.

Of the methods of drilling, and the care of the wells during

operation, a complete description is given, with diagrams of the machinery and tools used.

The transportation and uses of gas, its value as a fuel, the measurement of the wells, and the methods of piping, are described in detail.

The remaining pages of the report are devoted to the two principal coal-fields of the State, the manufacture of salt and bromine, cements, land-plaster, lime, etc.

Few of the States so thickly burdened with drift as is Ohio have so thorough a record of its depth over extended portions of their territory. Here it has been obtained by the drilling of the numerous oil-wells so fully, that a fair knowledge of the relief of the ancient preglacial surface of the State now exists. While in the northern counties the drift is of little thickness, in the western and central sections it at times reaches extraordinary depths, being in one case no less than five hundred and thirty feet thick.

Chambers's Encyclopædia. New ed. Vol. II. Beaugency to Cataract. Philadelphia, Lippincott. 8°.

ABOUT half a year has elapsed since the issue of the first volume of this new edition of Chambers's well-known Encyclopædia. Among the contributors we notice the names of many prominent scientists and literary men, and therefore we feel assured that the articles are in every respect a source of trustworthy information, and that they are up to date. The volume is profusely illustrated, and the illustrations are well selected. The maps have been made by Bartholomew and Johnston, and are up to the standard of the maps of their institutes. The present volume contains many interesting articles, among which we mention one on 'Bees,' by J. Arthur Thomson; 'Bimetallism,' by J. S. Nicholson; 'Blindness,' by F. J. Campbell; 'Bulgaria,' by A. Silva White; 'Robert Burns,' by Andrew Lang; 'Carboniferous,' by J. Geikie; and several military articles by Major Dunlop, R.A. The encyclopædia is well edited, the articles being carefully selected, and a judicious amount of space being allotted to the various subjects, according to their importance. The interests of the English and American public receive equal attention in this encyclopædia. Numerous articles might be quoted on account of the large amount of information conveyed in a small compass, and still well written. Among these we mention the article 'Bokhara,' which is principally founded on Vambéry's book of that country. Of special interest to the American public is the long article on 'Canada,' by J. G. Colmer, which is accompanied by two elaborate maps, — one of the Dominion, and the other of the eastern provinces. The article gives a brief review of the geography, commerce, and history of the province. The article 'California,' which is also accompanied by a map, has been written by Charles W. Greene. This, as well as other articles on subjects of special interest to America, has been copyrighted by the publishers. Among these are an interesting sketch of the Beecher family, and sketches of the cities of Boston, Brooklyn, Buffalo, and Cambridge. The remarkable career of John Brown the abolitionist is sketched. Other American men whose life and work are described in this volume are Artemus Ward (C. F. Browne), W. C. Bryant, Buchanan, Benjamin Franklin Butler, and John Caldwell Calhoun.

The National Revenues: A Collection of Papers by American Economists. Ed. by ALBERT SHAW. Chicago, A. C. McClurg & Co. 16°. $1.

Is Protection a Benefit? A Plea for the Negative. By EDWARD TAYLOR. Chicago, A. C. McClurg & Co. 16°. $1.

THE tariff question has now become the leading issue in American politics, and bids fair to remain so until it is definitely settled. The dispute between free-traders and protectionists has been in abeyance for some years past, owing to the greater prominence of the slavery question and the difficulties that grew out of it; but it has now arisen again, and in a more decisive form than ever. It presents itself, too, in a different form from that which it bore in the early part of the century. Then the protectionists advocated a high tariff only as a means of establishing manufactures, with the avowed intention of reducing it to a revenue basis at a later time; but now they desire to retain it as a permanent policy. What will be the ultimate outcome of the dispute that has now begun is a question with which we have here no concern, but there can be no doubt as to the importance of a correct understanding of the problem itself. Nor is it sufficient that the leaders of the people alone should understand it; for the appeal of both the parties in controversy is to the mass of voters, and by them it must be decided.

Under these circumstances, every book or essay that really teaches any thing on the subject is to be welcomed, and such works are already beginning to appear in considerable numbers. The titles of two of them stand at the head of this article; and both works have considerable merit, while at the same time neither can be called quite satisfactory. The first is a collection of twenty brief essays — some of them very brief — dealing with all aspects of the revenue question, and not with the tariff alone. The editor is a young student and writer on economic subjects, and the authors of the essays are mostly recognized authorities on the subjects of which they treat. The principal fault of the book is the extreme shortness of some of the articles, which hardly allows room for an intelligent expression of opinion, and wholly precludes reasoning. It would have been far better, in our opinion, to have had a much smaller number of longer and more argumentative papers. However, there is a good deal that is suggestive in the book, and it may stimulate the reader to further investigation. The majority of the writers favor a reduction of the tariff, and all of them oppose the repeal of the liquor and tobacco taxes; Professor Thompson of Pennsylvania, though an ardent protectionist, agreeing on this point with the free-traders. Another noticeable feature of some of these essays is the favor with which the writers regard schemes for spending the surplus revenue for internal improvements, and even for distributing it among the States, this last being a measure of very doubtful constitutionality, and of equally doubtful expediency. We have no space to speak of particular articles; but the names of Professors Walker, Ely, Adams, Laughlin, and others, Carroll D. Wright of the National Labor Bureau, and many competent writers besides, are a sufficient guaranty that the book is of real value in spite of its scrappy character.

The second book on our table is an argument for free trade by an ardent and well-informed writer. The reasoning is not so close and thorough as we find in the best English writers on the subject, — a remark that applies to most American works on economic themes, — but it presents the arguments for free trade quite fully, and in a plain and simple style. The author opens his work with a brief history of the protective system both in Europe and in America, but the greater part of the volume is devoted to a discussion of the question as it presents itself to-day.

In a few cases Mr. Taylor presses his conclusions, perhaps, a little farther than the premises warrant; but, as a rule, his reasoning is sound, and his answers to the protectionist arguments are in the main apt and conclusive. With regard to the contention that our national prosperity is due to the tariff, he shows that we were never more prosperous than under the low tariff prevailing from 1846 to 1860, and that our great prosperity is really due to other causes, with which neither protection nor free trade has any thing to do. Again, the protectionists have long maintained that protection raises wages, and that the high wages prevailing in this country are due to it. In reply to this, Mr. Taylor shows, that, although wages are lower in free-trade England than in the United States, they are much lower still in the protected nations of the European continent; and that Russia, which has the highest tariff of all, has also the lowest rate of wages; and his inference is that high wages are due to great natural resources and high efficiency of labor. The author gives chapters to the effect of the tariff on our foreign trade and shipping, to its bearing on the agricultural interest, and, indeed, to nearly all the aspects which the question presents. Such works as these two, notwithstanding some defects, can hardly fail to stimulate thought and discussion among the people, which alone can lead to the prevalence of right views, and to a final and satisfactory settlement of the controversy.

The Building of the British Isles. By A. J. JUKES-BROWNE. New York, Scribner & Welford. 12°.

THE restoration of the geography of past periods is a problem of peculiar interest; and one of the great aims of the science of geology is to reconstruct the history of development of the conti-

nents. In the present volume the author attempts to study the history of the British Isles. Although the available material is far from being complete, the long-continued and thorough researches in this narrow field enable the student to trace the more recent history with comparative exactness, while, on account of the incompleteness of the geological record and the difficulties of explaining the observed facts, the history of the ancient periods appears in many instances hypothetical. The author traces the history of the British Isles through all periods successively. Each chapter is illustrated by an interesting map showing the restored geography of that period, thus giving a clear insight into the probable history of development of this part of the globe. In each period first the physical conditions are discussed under which the rocks were formed, while the latter are described only so far as is necessary for ascertaining whence their component materials were derived, in order to form some conception of the relative positions of land and water during each of the successive periods of geological time. The maps of the more recent periods are based on the theory that the alternate rising and sinking of the area of western Europe was comparatively uniform, and therefore the present contour-lines appear as boundaries of the continent of those periods. The author's representation of pliocene geography differs from previous restorations in extending the area of land in Scotland and around the Faroe Islands. For the early pleistocene time the author assumes the eighty-fathom line to be the coast-line, while the land from that time on continues to sink. He favors throughout the theory that the oceanic basins are not absolutely permanent, and his conclusions are based on his studies of the history of the British Isles, which he has so comprehensively represented in the present volume. He thinks that the absence of deep oceanic deposits among the paleozoic rocks may be taken as indicative of a great difference in the general relations and proportional areas of land and sea, the probability being that there were neither oceans nor continents like those which now exist, but an irregular distribution of comparatively shallow seas among land-tracts of moderate elevation. In neozoic times proof of the existence of oceans is found, though these do not seem to have been so deep as those of the present day. That there were also large tracts of continental land is proved by the traces of large rivers and large inland lakes; but, so far as we know, these land-tracts did not form the nuclei of the modern continents of Europe, Asia, and Africa, or bear any definite relation to these continents. From this he concludes that the deep oceanic basins and lofty mountain-ranges of the modern world have been formed by a long process of evolution, the tendency of all recent geographical changes having been to deepen the ocean-basins, and to raise the mountain-peaks to higher and higher elevations. In the discussion he dwells on the theory of the formation of the English chalk, and against other authorities maintains that it has probably been formed in a deep sea.

American Commonwealths. Indiana. By J. P. DUNN, jun. New York, Houghton, Mifflin, & Co. 16°. $1.25.

THE author of this work has seen fit to close it with the admission of Indiana into the Union as a State in 1816, but for what reason we are unable to see. The history of the State, and of its share in national affairs, is surely as important as that of the Territory; and the account that Mr. Dunn here gives us has the appearance of a fragment. It is true that it fills a volume as large as the others of the series to which it belongs; but this is only effected by diffuseness of style, and prolixity of narrative, — faults that we have noticed in some other volumes of the series. Then the map at the beginning of the book is singularly inappropriate to this work; since it shows Indiana as it is now, while the narrative relates entirely to the territorial period. Notwithstanding these defects, however, the work has considerable merit. The author shows familiarity with his subject, carefulness in collecting facts, and an evident desire to be just to all persons and parties; and he evinces a patriotic interest in his State without undue partiality.

The history of Indiana, as far as it is related by Mr. Dunn, naturally divides itself into two periods: the first embracing the early exploration and settlement of the country; the second, the later colonization from the Eastern States and the political contests among the people. The first settlements were those of the French, who passed down the Wabash on their way from Canada to the Mississippi and New Orleans. The most important of their posts, and for a long time the capital of the whole region, was Vincennes, which Mr. Dunn thinks was founded in 1727, though the date is uncertain. The growth of population was for a long time so slow, that in 1800 the white people of what is now Indiana numbered only about twenty-five hundred, and the extent of the immigration from the East and South is shown by the fact that in 1815 the number was over sixty-three thousand. Mr. Dunn's account of the early French inhabitants brings before us a state of society that has long since passed away, and is one of the most pleasing features of the book. The most important part, however, as the author clearly perceives, is the struggle over the admission of slavery into the Territory. The famous ordinance enacted by Congress in 1787 forbade slavery in all the region north and west of the Ohio; but this was construed to apply only to persons born in or immigrating into the Territory after the ordinance was passed; and those who were slaves at the time of its passage remained so. The French settlers, however, and some of those from the Southern States, wanted to re-establish slavery, and repeatedly petitioned Congress to repeal the slavery proviso, which Congress steadily refused to do. But at length the anti-slavery men became a majority in Indiana; and when the State entered the Union its Constitution contained a provision prohibiting slavery forever. Besides these leading themes, Mr. Dunn's pages convey a good deal of information on minor matters; and particular attention is given to men like La Salle, Vincennes, Governor Harrison, and others, who were prominent in Indiana's early history.

PUBLISHERS' FALL ANNOUNCEMENTS.

Ginn & Co.

'A Pamphlet of Parallel References,' prepared by John Williams White of Harvard College, to adapt his 'First Lessons in Greek' to the Hadley-Allen 'Greek Grammar,' will be published the latter part of October. A new edition of Allen & Greenough's 'Latin Grammar' will be published in November. The book has been entirely re-written; but the sections of the new edition will correspond with those in the old, so that the two can be used together. 'The Brutus of Cicero,' edited in the College Series of Latin Authors, by Prof. Martin Kellogg of the University of California, will be published in December. A new edition of Professor Byerly's 'Integral Calculus' may be expected in November. 'The History of Greek Philosophy,' by B. C. Burt, formerly fellow and fellow by courtesy in the Johns Hopkins University, will be published the 1st of November. 'A General Astronomy,' by Prof. C. A. Young of Princeton College, will be published the latter part of December. It is a college-book, and will be fully illustrated with cuts and diagrams. 'Footprints of Travel, or Journeyings in Many Lands,' by M. M. Ballou, author of 'Due West,' 'Due East,' etc., will be published early in November. This is a volume of geographical readings, presenting vivid pictures of countries visited by the author. *The London Classical Review* has enlisted the co-operation of leading American scholars, and Ginn & Co. are to be the American publishers. 'Voices of Children,' by W. H. Leib of Kansas City, will be published in November. 'Teacher's Handbook of Arithmetic,' by G. C. Shutts of the Whitewater (Wis.) Normal School, will be published early in December. A new edition of Lanman's 'Sanskrit Reader' may be expected the latter part of October. This will include the long-promised notes, and the notes will also be put in a separate volume. 'The Beginner's Book in German,' by Miss Sophie Doriot, will be issued in December. This is to be a companion volume to Miss Doriot's 'Beginner's Book in French,' which has been so highly commended. An edition of 'Tom Brown at Rugby,' authorized by Mr. Hughes, will be published in the series of Classics for Children in about two months.

E. L. Kellogg & Co.

The list of books for teachers now embraces fifty titles. The new ones now ready are, 'Gardner's Town and Country School Buildings,' containing twenty-five designs of schools of all grades, but specially of country schoolhouses, with 150 illustrations;

'Southwick's Quiz Manual on Theory and Practice of Teaching;' 'Welch's Talks on Psychology,' by A. S. Welch of Iowa; 'Welch's Teachers' Psychology' (ready in November); 'Dewey's How to teach Manners,' by Mrs. J. M. Dewey; Teacher's Manuals Series, four new numbers (ten numbers in all), — 7. 'Huntington's Unconscious Tuition,' 8. 'Hughes's How to keep Order,' 9. 'Quick's How to train the Memory,' 10. 'Hoffmann's Kindergarten Gifts.'

A. C. McClurg & Co.

'Montesquieu,' by Albert Sorel (The Great French Writers Series), translated by Melville B. Anderson; 'Astrophel and Stella,' by Sir Philip Sidney, edited by Alfred Pollard, with portrait of Sidney; 'Shelly: The Man and the Poet,' by Felix Rabbe; 'Victor Cousin, the Distinguished French Philosopher, Orator, and Educator,' by Jules Simon of the French Academy (The Great French Writers Series), translated by Melville B. Anderson and Edward Playfair Anderson; 'The Standard Symphonies: their Stories, their Music, and their Composers,' a handbook, by George P. Upton; 'Manual of the Vertebrate Animals of the United States, including the District North and East of the Ozark Mountains, South of the Laurentian Hills, North of the Southern Boundary of Virginia, and East of the Missouri River, inclusive of Marine Species,' by David Starr Jordan, president of the University of Indiana (fifth edition, entirely rewritten and greatly enlarged); 'Turgot,' by Léon Say of the French Academy (The Great French Writers Series) translated by Melville B. Anderson.

Charles Scribner's Sons.

The first volume of the 'Cyclopædia of Music and Musicians, edited by John Denison Champlin, jun., with William F. Apthorp of Boston as critical editor, stands at the head of the list. The work will consist of three quarto volumes, this edition being limited to five hundred numbered sets for this country, and fifty for England. An important feature of the work will be the illustrations. Modern art has been so influenced by the French schools of painting, that a new work which analyzes and traces to its source this influence will be sure of a hearty welcome. Such a work is Mrs. C. H. Stranahan's 'A History of French Painting.' The reminiscences, sketches, and comments of the Hon. Hugh McCulloch are especially noteworthy for the information they contain regarding the 'Men and Measures of Half a Century.' The second volume of 'Around the World on a Bicycle' carries the adventurous rider, Thomas Stevens, across Asia from Teheran to Yokohama. The sixth volume of Dr. Philip Schaff's 'History of the Christian Church' deals with the German Reformation between 1517 and 1530. 'Dogmatic Theology,' by Dr. William G. T. Shedd. A new and revised edition of Corea, by William Elliot Griffis, who has brought this popular book about 'The Hermit Nation' down to date. In 'Little People of the Meadows, Woods, and Waters,' by Stella Louise Hook, the author describes the lives of familiar insects. The popularity of Miss Wright's two previous volumes, 'Children's Stories of American Progress' and 'Children's Stories in American History,' insures a cordial reception for her new book, 'Children's Stories of the Great Scientists.' New and cheaper editions are announced of Charles F. Holder's three books, 'Living Lights,' 'Marvels of Animal Life,' and 'The Ivory King,' the general title for the set being 'Marvels of Animal Life Series.' Boys will also be interested in 'Wild Men and Wild Beasts,' by Colonel Gordon-Cumming.

Scribner & Welford.

D'Anvers's 'Elementary History of Art,' with a preface by Prof. Roger Smith (new edition in 2 vols.). 'Francis the First and his Times,' by Julia Pardoe, with numerous portraits and illustrations on steel (new edition). 'Louis the Fourteenth and Court of France in the Seventeenth Century,' by Julia Pardoe (new edition). 'Life of Matthew Fontaine Maury,' compiled by his daughter, Diana Fontaine Maury Corbin, with portrait. 'Leaves from an Egyptian Note-Book,' by Isaac Taylor, LL.D., canon of York. 'Tropical Africa,' by Henry Drummond, F.R.S.E., F.G.S., with six maps and illustrations. 'Caldecott's North Italian Folk,' sketches of town and country life, by Mrs. Comyns Carr, illustrated by Randolph Caldecott. 'Princetoniana: Charles and A. A. Hodge, with Class and Table Talk of Hodge the Younger,' by a Scottish Princetonian, the Rev. Charles A. Salmond, M.A., Rothesay, with portraits, etc. Vol. II. of 'History of the Christian Philosophy of Religion,' by Professor Pünjer, translated by W. Hastie, B.D., with an introduction by Prof. Robert Flint. 'The Hibbert Lectures, 1887,' lectures on the origin and growth of religion as illustrated by the religion of the ancient Babylonians, by A. H. Sayce. In Bohn's Libraries, 'Lucian's Dialogues;' 'Julian the Emperor;' 'History of Prose Fiction,' by John Colin Dunlop; 'Lives of the Tudor and Stuart Princesses,' by the late Agnes Strickland; 'The Building of the British Islands, a Study in Geographical Evolution,' by A. J. Jukes-Browne; and 'Plutarch's Morals.'

Miscellaneous.

The 'Eclectic Shorthand Dictionary,' by Prof. J. George Cross, M.A., was published Aug. 18, by S. C. Griggs & Co., Chicago. This book is supposed to be particularly beneficial to beginners on account of the phonic spelling given. —— The eighth volume of Alden's 'Manifold Cyclopedia' extends from 'Ceylon' to 'Club-Foot.' —— In the *Andover Review* for October, Professor Stoddard, of the University of California, draws a comparison between two important and opposing tendencies of literature represented by Tolstoï and Matthew Arnold; Professor James, of the University of Pennsylvania, considers 'Manual Training in the Public Schools in its Economic Aspect,' and he argues forcibly for its introduction into our educational system; there are editorials upon elementary education in England and Wales, etc. —— 'The Effects of Protection,' by Charles S. Ashley, will be the leading article in *The Popular Science Monthly* for November (it is an important contribution to the tariff discussion, showing the expensiveness of protection, the small number of those benefited by it, its failure to keep up wages, its influence in checking our export trade, and its effect in making us "a nation of liars," and our government a heedless spendthrift); the question how long man has lived in America, and what were the surroundings of the primeval inhabitant, will be discussed in an illustrated article, entitled 'Paleolithic Man in America,' by W. J. McGee; the vice-presidential address given by Charles W. Smiley before the American Association, on 'Altruism Economically considered,' will be published; and 'The Prolongation of Human Life' will be treated by C. M. Hammond. —— Gen. A. W. Greely, chief signal officer, has written for the November *Scribner's* an article entitled 'Where shall we spend our Winter?' which will be of great value to invalids and pleasure-seekers. —— Brentano's will publish immediately Sir Morell Mackenzie's work in relation to the case of the late Emperor Frederick, embodying his reply to the German physicians. The book will have not only value to the medical profession, but great interest to the general public. A facsimile letter of the dying Emperor Frederick, and other illustrations, will be given in the volume. —— The Euclid Publishing Company of Chicago will issue in a few days 'The History of the Bank of England,' by Joseph Hume Francis. —— Thomas Whittaker will publish shortly the next volume in the Camelot Series, 'Irish Fairy-Tales and Folk-Lore,' selected and edited by W. B. Yeats; in the Great Writers Series, 'Life of Crabbe,' by T. T. Kebbel. —— D. Appleton & Co. have just published the fifth volume of 'Appletons' Cyclopedia of American Biography.' They have also just issued an 'Index to Appletons' Annual Cyclopedia' for the twelve volumes, 1876–87. —— James Clegg, Rochdale, Eng., has just published his 'Directory of Second-hand Booksellers, and List of Public Libraries, British and Foreign.' Besides the lists of booksellers and libraries, Mr. Clegg gives a list of fictitious names used by authors and illustrators; ancient centres of printing, with their Latin equivalents; bibliographical works of reference; journals of the book-trade; copyright registry; etc. The book may be obtained in this country through B. Westermann & Co. —— The latest addition to the list of Volapük journals is the *Van Kua Tung Hua*, published in China by a Chinese. The paper prints the Chinese characters and the translation in Volapük. The object will be to teach the Chinese Volapük, and Chinese to those who understand the 'universal language.' —— The first number of *Our Young Folks' Monthly*, the organ of Our Young Folks' Reading-Circle, has been issued. Mr. S. R. Winchell of Chicago is managing editor.

NOTES AND NEWS.

THE University of Texas at Austin has instituted a school of geology, which is conducted by Robert T. Hill. It is intended to arrange two classes, — one for those who desire a general knowledge of geology, and the other for those who wish to become practical geological investigators and teachers. A circular has been issued in which the programme of the school is fully set forth.

— The rapid development of Southern California has brought Lower California into prominence, and recent explorations have shown that it is not at all that desert land which it has long been supposed to be. In a book by Charles Nordhoff, 'Peninsular California,' recently published by Harper & Brothers, the merits of the northern section of the territory are set forth. This district belongs to the Mexican International Company of Hartford, Conn., which attempts to found colonies there, and to promote agriculture. Nordhoff's volume is accompanied by interesting illustrations, showing the character of the vegetation of that region, and views of beautiful orchards and wooded mountains. In an appendix meteorological data are given, and the timber region and recent gold discoveries are described.

— Mr. Samuel H. Scudder, Cambridge, Mass., will shortly publish an extensive treatise on the 'Butterflies of the Eastern United States and Canada, with Special Reference to New England.' The preparation of this work was first announced by the author in 1869, in the *American Naturalist* and other journals of the day. It has thus been twenty years in progress, and represents eight years of undivided attention to its elaboration. In this long time the author has not only availed himself of the personal aid of a host of willing friends and correspondents, who have confided to him their voluminous field-notes and numerous specimens, but he has carefully gleaned every fact of value from the natural-history journals and other publications, and supplemented all by his thirty-five years' experience in the field. No systematic work on butterflies has ever appeared in any language comparable with it in the complete elaboration of a single limited fauna, in attention to every stage of life, thorough and excellent illustration of every period of the butterfly's existence, and in careful detail of all structural features. It contains 17 plates of butterflies, 6 of eggs, 11 of caterpillars, 2 of the nests of caterpillars, 3 of chrysalids, 2 of parasites, 33 of structural details in all stages of life, 19 maps and groups of maps to illustrate the geographical distribution of the butterflies, and 3 portraits of early naturalists of this country, — in all, about 2,000 figures on 96 plates, of which 40 or more are colored; the butterflies in a style of chromolithography never surpassed, if it has ever been equalled in similar illustrations, whether in Europe or America. The printing of the plates was begun three years ago, and is now nearly completed. The work will be issued in twelve monthly parts, to be sold at five dollars per part, or fifty dollars on or before Jan. 1, 1889, for the complete work.

— A prize of one hundred and fifty dollars will be awarded by the American Economic Association for the best essay on 'The Evil Effects of Unrestricted Immigration.' This prize is offered by *America*, the new Chicago weekly; and the essay will be known as the '*America* Prize Essay.' Any person is eligible to competition, provided his article does not exceed twenty-five thousand words, and is received by the secretary of the association before April 30, 1889. Each essay must be type-written, signed by a fictitious name, and accompanied by a sealed envelope containing the name assumed as well as the address of the author. For further information, address the secretary, Prof. R. T. Ely, Johns Hopkins University, Baltimore, Md.

— The collection of papyri of Archduke Rainer has been the subject of careful researches. J. Wiesner has made a microscopical and chemical inquiry, while J. Karabacek studied it from an historical point of view. The results of their inquiries shed an entirely new and unexpected light upon the history of the manufacture of paper. It is shown that the art of making paper of linen was first carried to Samarkand by Chinese captives in A.D. 751, when the governor of Samarkand made war upon the princes of Ferghana and Shash, who were tributaries of China. Wiesner as well as Karabacek shows that cotton paper, which was generally assumed to have been the first paper manufactured, never existed. In Samarkand the manufacture of paper from linen rags was invented by Persians, and this invention gave a great stimulus to the manufacture. Samarkand papers were famous all over the Orient and Occident until the eleventh century. Later on, factories were established in Bagdad and Egypt, and it was then that paper took the place of the ancient papyrus. The researches of Wiesner show that these early papers were white, and that they were filled and sized by means of starch. It is of great interest that Wiesner's conclusions as to the methods of manufacture of the early papers have been fully confirmed by the recent discovery of an ancient Arabian manuscript describing the manufacture of paper in detail. Cotton was never used for making papers in those early days.

— The *Naturwissenschaftliche Rundschau* gives an abstract of an interesting lecture of Ch. André, who has made a series of experiments on magnetic disturbances. It is well known that magnetic disturbances originate on the whole earth simultaneously, and that they are caused by the action of the sun. Ch. André found that they originate when a place of disturbance on the sun passes its apparent centre. He says, "If by a continuous series of observations the successive situations of regions of activity on the sun are determined, which either appear as spots or *faculæ*, or only as *faculæ*, it will be seen that every great magnetic disturbance coincides with the passing of this region through the apparent centre of the sun. Those among these regions which remain for several revolutions of the sun on the same spot, cause a magnetic disturbance every time they pass the centre of the sun, while no disturbances are observed when no such region is on that spot of the sun's surface lying between his centre and that of the earth." This phenomenon occurs so regularly, that André was enabled to predict a disturbance as soon as a spot appeared on the eastern limb of the sun.

— The 'Fifth Annual Report of the Ohio Meteorological Bureau' contains, besides the usual summaries, a few interesting phenologic tables, the first being a statement on the migration of birds as observed at Wauseon, Fulton County, in 1887, by Thomas Mikesell. It contains the dates of arrival and departure of seventy-five species of birds, with notes on the frequency of their occurrence. The next table gives phenological observations on forest and other trees, the date of the opening of buds, the time when the trees are in leaf and in blossom, and the ripening of the fruit. The change of foliage and the falling-off of the leaves are also noted. Besides this, we find tables giving the dates of the blooming of plants. Work of this kind is highly welcome to the student of biology, as well as to the geographer. There are at present forty-one stations in operation, reporting to the Ohio Meteorological Bureau.

— In the signature of the Proceedings of the United States National Museum just issued, Mr. George F. Kunz gives an interesting account of the meteoric iron which fell in Johnson County, Ark., on March 27, 1886. The report is remarkable on account of the great care bestowed by the writer upon ascertaining the history of the fall as observed by eye-witnesses. A thorough description of the iron is given. Its upper side is ridged and deeply indented, being in many places almost tin-white, while the lower side is flat and covered with large, shallow pittings. The writer concludes, that, after entering our atmosphere, the iron travelled with the ridged surface forward, the iron burning so rapidly as to be torn off, leaving part of the surface bright. The flame thus passed over the sides, and, the indented edge being downward, the flame was driven upward as the iron advanced. The flat side not being so much exposed, the iron was not so completely consumed, hence a crust and large but shallow pittings. These conditions would perhaps have been entirely different had the mass been round or thicker, for it evidently moved as straight as possible without rotating at all. That it was found in the earth with the flat side down, was due perhaps to the fact that it turned after losing its highest velocity.

— The fifth annual convention of the Iowa Assembly of the Agassiz Association was successfully held at Mount Pleasant, Aug. 21, 22, and 23. Representatives from fourteen chapters were present, making the largest representation in the history of the assembly.

Five chapters were admitted to membership. The first day of the convention was devoted to committee-meetings, addresses, and reading of papers. In the evening a reception and banquet was tendered to the delegates by Chapter 700, at the home of Miss Crane. The second morning was given to the president's address, competition for diplomas, reading of papers on modes of work, and exhibition of specimens. In the afternoon the assembly visited the Iowa State Hospital for the Insane, and were shown through the institution by Dr. F. P. Peck, who in the evening delivered before the assembly a very interesting and profitable lecture entitled 'Notes on the Anatomy of the Brain.' The usual convention picture was taken during the afternoon. The third and last day of the convention was devoted, in the morning, to the reading of papers, debate, and miscellaneous business; in the afternoon, to awarding the diplomas, general business, and election of officers. Diplomas awarded for the best records of work done during 1887–88 were as follows: first, to Chapter 653, of Oskaloosa; second, to Chapter 20, Fairfield; third, to Chapter 812, Davenport. Officers elected were: John G. Speilman, Chapter 20, Fairfield, president; Fred B. Palmer, Chapter 653, Oskaloosa, vice-president; Fred M. Irish, Chapter 285, Dubuque, 2d vice-president; Miss Olive Cole, Chapter 700, Mount Pleasant, secretary; Belmont A. Goam, Mount Pleasant, continuing in office as treasurer. Oskaloosa was chosen as the place of the next convention. Enough praise cannot be given to the members of the entertaining chapter, A.A. 700, for their hospitality and good management, which has made the fifth annual convention of the Iowa Assembly of the Agassiz Association a meeting which will never be forgotten.

— The Congress of Americanists, devoted to researches into the pre-Columbian history of this continent and into the languages and character of its aboriginal tribes, met in Berlin on the 2d instant. We may be able to give some account of the proceedings in a future number. The next meeting will be held in Paris in 1889. It is hoped that arrangements may be made for a meeting of this learned body in the United States. An error occurred in the telegraphic announcement of the opening, last week, which mentioned "Horatio Hale of Clinton, Ontario," as among the members present. Mr. Hale was not able to be present, but sent a communication to be read by another member. The appearance of his name in the printed list of contributors doubtless led to the error.

— One of the annoyances connected with the use of instruments containing lenses, in the examination of the cavities of the body, is due to the fact that they become dim by the deposition of moisture. Dr. Stocquart claims that this can be prevented by spreading a drop of glycerine on the lens.

LETTERS TO THE EDITOR.

A Notable Evolution.

YOUR number of Sept. 7 coming to hand yesterday, I find in it a letter under the above title, from Mr. E. P. Powell, that seems likely to mislead those not informed on the subject. After the statement that "every one knows what a clumsy singer" the robin is, it goes on to describe the peculiar musical powers now noted in some few individuals. The mere fact of such great rapidity occurring in the robin's musical evolution would of itself cause suspicion that the former state had not been well observed. Now, the fact is, that the robin is not, and for several years has not been, a clumsy singer, when it wishes to exert itself. That it is not as constant a songster as the majority of song-birds may be accounted for by its lazy habits, remarked by Mr. Powell. It is quite true that its more common notes are quite unmusical in character, but in noting any song-evolution it will not do to overlook its other, not infrequent song. It is now some fourteen years since I first began to collect birds and study them in a practical manner. I am positive that at the beginning of that time the robin was no mean songster. From five to seven o'clock in a summer or early fall evening it is an almost daily occurrence for them to take their stand on the topmost bough of some tall tree, and for an hour or more pour forth a flood of melody. This song isn't a repetition of a "rough seesaw note," but a variety of very liquid notes rendered in a most musical manner. Nor is this song confined alone to the evenings, but may often be heard during the day. Such, at least, were the robins of Rochester, N.Y., and many other localities with which I was familiar for the past fourteen years. Whether any change has taken place there within the past year, I cannot say, for I have not been within hearing distance of a robin for that time.

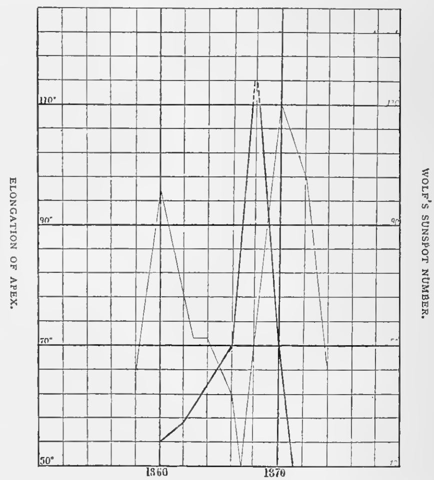
Mr. Powell's stricture on Professor Baird's remark about the catbird strikes me as a trifle unfair. It can't be supposed that Professor Baird was unacquainted with the mimicking-powers of this bird. The merest tyro in ornithology, who lives anywhere in their vicinity, must be acquainted with this. What Professor Baird stated was perfectly true as far as it went; for their 'mewing' is *the* characteristic note: hence the name 'catbird.'

HENRY L. WARD.

Tacubaya, D.F., Mex., Sept. 20.

The Zodiacal Light.

A DISCUSSION of the long series of observations on the zodiacal light by Heiss and Weber (1843–83), and also a ten-year series by Backhouse, having shown a clear connection between the extent of the zodiacal light and the condition of the solar surface, as is shown in the following curves drawn from observations made by Backhouse, in which the heavy line indicates the mean yearly elongation



of the zodiacal light, and the light line the course of Wolf's relative sunspot numbers, I am, for the sake of other connections foreshadowed, anxious to obtain as many observations of the zodiacal light as possible. The material is, however, badly scattered, and compels me to ask through your columns that any who know the whereabouts of such observations would kindly call them to my attention.

O. T. SHERMAN.

Baltimore, Md., Sept. 29.

Periodicity of Thunder-Storms.

THE researches of Von Bezold in regard to a periodicity of thunder-storms corresponding to the time of the rotation of the sun, referred to in *Science* for Oct. 5, on p. 167, corroborate the results secured by the writer. In certain years this periodicity becomes more evident. In 1886 for months together it was very plainly apparent upon the most cursory examination. In other years more complete information from wider areas has been necessary in order to bring it out clearly. It seems to me strange that any one should ignore facts because their full significance may not be clearly understood at present. The note which you publish in regard to Von Bezold shows that he was inclined to do this, and this tendency appears to be specially difficult to overcome in the investigation of this subject.

M. A. VEEDER.

Lyons, N.Y., Sept. 8.

Schools.

SCIENCE

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SCIENCE

FRIDAY, OCTOBER 19, 1888.

IN THE *Contemporary Review* for July is an interesting article by Frances Power Cobbe on 'The Scientific Spirit of the Age,' one portion of which, at least, expresses our own views on the subject, and we presume that of others. She says, "The political press has adopted the practice of reporting the details of illness of every eminent man who falls into the hands of the doctors, and affords these gentlemen an opportunity of advertising themselves as his advisers. The last recollection which the present generation will retain of many an illustrious statesman, poet, or soldier will not be that he died like a hero or saint, bravely and piously, but that he swallowed such and such a medicine, and perhaps was sick in his stomach. Death-beds are desecrated that doctors may be puffed and public inquisitiveness assuaged." We believe, however, that the "political press" is more to blame for this than the "doctors." While it is true that some of these seize with avidity every such opportunity to bring themselves into notoriety, yet there are others (and these we believe are in the majority) who shrink from the publication of their opinions, and would oftentimes prefer to relinquish the case rather than to be brought forward so prominently before the public. It was a matter of deep chagrin to the late Prof. Frank Hamilton that his name figured so often in the public press while he was in attendance upon President Garfield during his fatal illness. The position of a physician who is in attendance upon an illustrious personage is a most trying one. The public demands professional opinions; and, whether the physician communicates them to the representatives of the press or withholds them, he is equally condemned. Miss Cobbe would place the medical profession under great obligations if she would indicate just what course its members should follow under these circumstances.

AT THE LAST MEETING of the New York Academy of Sciences, Dr. A. Julien and Prof. H. C. Bolton gave a report of the interesting results of their long-continued researches on sonorous sands. The cause of this remarkable phenomenon, which was first known to occur in Arabia, has long been a mystery. In course of time many other localities in which sonorous sands occur became known, and, in fact, it may be found almost everywhere on beaches and in deserts. The authors collected samples from all parts of the world, and, on close examination, found that all sonorous sands are clean; that no dust or silt is found mixed with the sand; that the diameter of the angular or rounded grains ranges between 0.3 and 0.5 of a millimetre; and that the material may be siliceous, calcareous, or any other, provided its specific gravity is not very great. When these sands are moistened by rain or by the rising tide, and the moisture is evaporated, a film of condensed air is formed on the surface of each grain, which acts as an elastic cushion, and enables the sand to vibrate when disturbed. In sands mixed with silt or dust, these small particles prevent the formation of a continuous air-cushion, and therefore such sands are not sonorous. If this theory be correct, sonorous sand must become mute by removing the film of air. Experiments of the authors prove that by heating, rubbing, and shaking, the sand is 'killed.' All these operations tend to destroy the film of air condensed on the surfaces. On the other hand, samples of sonorous sand were exhibited which had been kept undisturbed for many years. They had retained their sonorousness, but, after having been rubbed for some time, became almost mute. The theory advanced by the authors appears very plausible, and will be firmly established when they succeed in making a sonorous sand. Their experiments in this line have not yet been completed, but promise fair success.

MEDICAL LEGISLATION IN NEW YORK.

IT is more than probable that additional legislation will be sought from the next Legislature of New York to control the practice of medicine. Mr. W. A. Purrington, counsel for the Medical Societies of New York County and State, recently read a paper before the American Social Science Association on the extent to which legislation can aid medical education. Legislators will do well to study this paper before introducing any new laws pertaining to the subject. Mr. Purrington thinks that a responsible board should be created, that will have in charge the arrangements of quarantine and sanitation, and also the licensing of medical practitioners of every sort; for he contends that the dentist and the pharmacist should be recognized as medical men. All that legislation can do to aid medical education he believes can be summed up as follows: —

I. By fixing a minimum age under which they (physicians, dentists, and pharmacists) will not be allowed to practise their calling.

II. By requiring of each of them a fixed term of study of certainly not less than two graded years, leaving to the board the care of details.

III. By requiring proof by examination or certificate that each candidate for license had studied, before beginning his professional course, at least those branches in which law students are examined in this State before they commence their legal studies.

IV. By declaring that no medical schools (including in the term schools of dentistry, pharmacy, and midwifery) shall be incorporated by special act, and providing a general law for the incorporation of such schools, only upon proof made of the possession by the incorporators of sufficient capital — say, not less than a hundred thousand dollars — and a teaching plant, to justify the belief that the school will be capable of exercising faithfully its franchise. Such an act should contain stringent provisions for its own enforcement and for the forfeiture of abused charters.

V. A minimum course of medical study should be prescribed, in which a grade of at least seventy per cent should be attained on examination. The regulation of all details of the examination should be left to the board. But the topics in which the examination should be had might well be specified in the statute. It might be well to omit the topics of therapeutics and materia medica, upon which all medical heresies have been begotten by unscientific minds, inferring that one who should creditably pass his examinations in botany, chemistry, physics, anatomy, surgery, physiology, hygiene, diagnosis, obstetrics, and microscopy, especially if his clinical examination should show him to be educated in a true sense to observe and draw sound deductions from observation, might be trusted to form his own conclusions and pursue his own studies as judgment should dictate in the field of therapeutics. The law can have nothing to do with medical theories. The utmost it can do successfully is to prescribe that none shall practise medicine except persons educated in those branches of science that all admit are essential to an understanding of morbid conditions of our species, and possessed besides of a fair general education.

VI. Finally, the law should not recognize any diploma as of itself conferring a right to practise medicine: even if the possession of such document should be required as an antecedent to examination by the health board, it should not be allowed to take the place of such an examination. Any scheme of medical legislation will hereafter embrace that great safeguard against imposture and efficient tracer of frauds, the system of registration, where no one is allowed to practise medicine who has not made a public record, under oath, of his name, origin, and credentials for a license.

A RUSSIAN PACIFIC RAILROAD.

THE question of a rail connection of the Baltic with the Pacific Ocean through Russia and Siberia has frequently been discussed, and recently steps have been taken to carry out part of this great enterprise. Political as well as economic reasons make the establishment of a better connection between Siberia and Russia appear very desirable. The remoteness of the Amur Province from the mother-country makes the security of this possession appear doubtful, and the immense distance of Siberia from any market renders its produce almost valueless.

The experience of American railroads shows that there is no better means of developing the productive capacity of a country than by the establishment of railroads. Siberia is capable of becoming a highly productive country, and the limits of its productiveness can hardly be conceived. The history of the settlement of the American and Canadian North-West Territories shows that an excessively continental climate is not a serious drawback to the development of a country. Southern Siberia has great agricultural resources; large tracts of land are well adapted for stock-raising; and its forests and mineral resources are of great value. While precious metals yield even now a considerable income, its rich coal and iron deposits have hardly been explored. The abundant supply of furs and fish needs only to be mentioned. At present a large portion of the grain grown in this country is used for distilling alcohol, as there is no market for it.

The only thing needed is better means of communication. The large rivers of Siberia, which flow into the Arctic Ocean, are not available for this purpose, as their mouths cannot be reached regularly from Europe, and as they are frozen during the greater part of the year. Numerous attempts have been made to ascertain the feasibility of a regular intercourse between the Atlantic ports and the mouths of the Siberian rivers; and, from the experience of Captain Wiggins, it would seem that the route is not so impracticable as it appeared to be. He succeeded eleven times in making the journey from England to the mouth of the Yenissei, and up to Krasnoyarsk, and proved that this trade may become of some importance, although the difficulties are so formidable that only the remoteness of central Siberia makes its use practicable. Another project of making the great rivers of Siberia more useful is that of a railroad from the Obi to a point west of the Strait of Kara. Although this plan might help to develop to a certain extent the resources of western Siberia, it would hardly prove adequate to opening the most productive parts of this vast country.

In summer the rivers afford a good means of intercourse, and plans have been made to improve them. The most important of them is the connection of the Obi and Yenissei by means of a canal, work on which is in progress. When this canal is completed, the following line will be open to commerce,— from Tyumen, the terminus of the Perm-Tyumen Railroad, down to Tobolsk,— and, following the Irtish, vessels will reach the Obi at Samarovsk. From here they will ascend the latter to the point where it approaches nearest to the Yenissei. Following the canal, they will reach the Yenissei, which is descended down to the confluence of the Upper Tunguska, which comes from Lake Baikal. In East Siberia the Amur affords good means of communication. The route follows the Chilka, and its tributary the Ingoda, as far as Chita. The distance between this point and Lake Baikal is not very long.

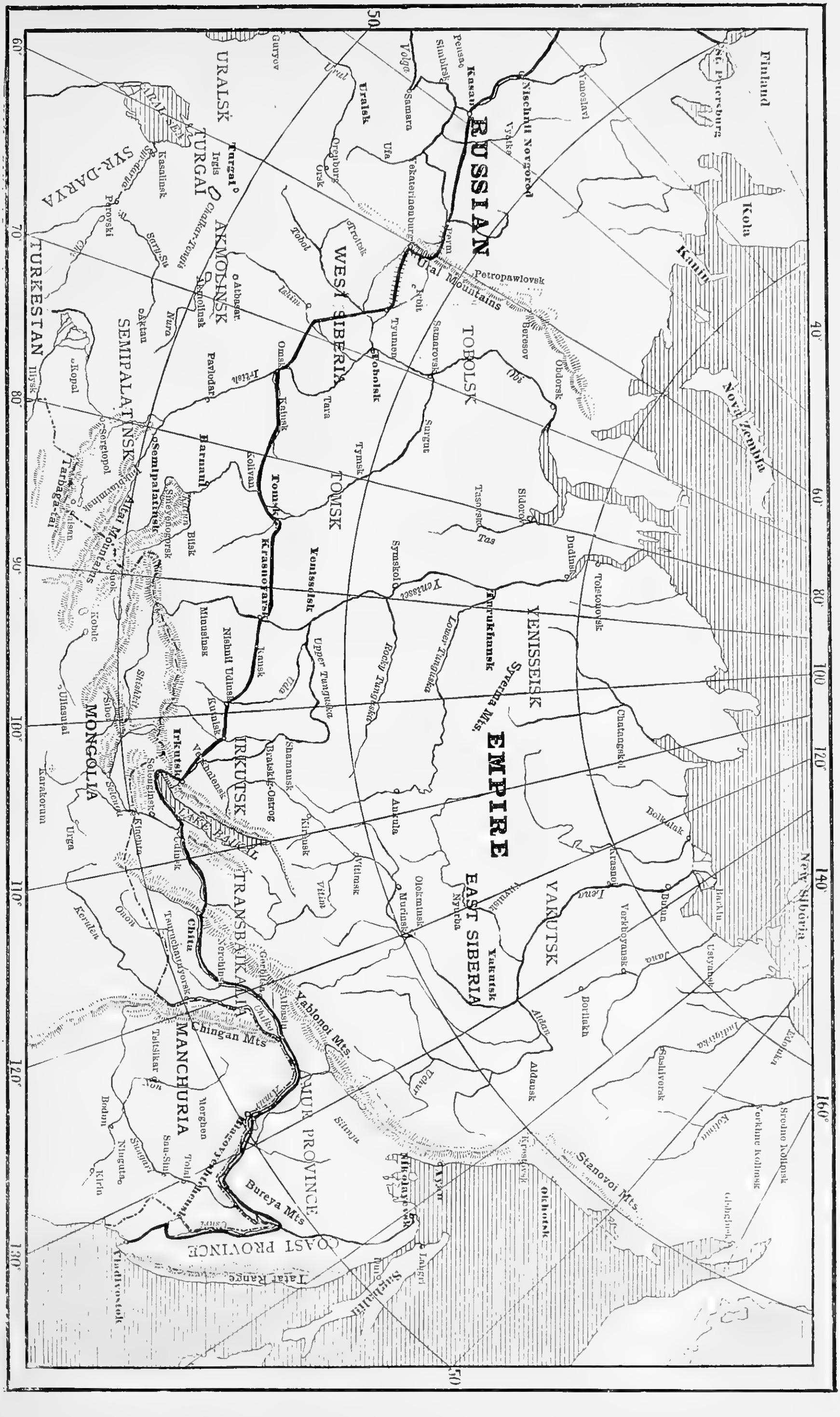
It seems that it has been decided to build first those portions of the Pacific Railroad which will supplement those sections which are open to river-navigation. This requires the building of the sections from Vladivostok to the mouth of the Usuri, from Chita to the Selenga, and from Irkutsk to Tomsk. The last is necessary, as the Upper Tunguska would require very expensive regulation. Should these works be completed, and reasonably fast-going steamers be put upon the rivers, the development of Siberia will receive a strong stimulus.

The effect of this improved inland connection upon the development of manufactures and industries will be great. At present eighty per cent of the total manufactures of Siberia belong to the territories Tobolsk and Tomsk. According to the reports of the Bureau of Statistics, there are 2,300 factories, which employ 12,500 men, and produce 14,000,000 rubles' worth of goods annually. The principal manufactures are those which use raw animal material: 500 tanneries produce goods valued at 3,000,000 rubles, and 150 tallow-factories have an annual output of 2,000,000 rubles in value. Next in importance are manufactures based on raw vegetable material. The rich mineral deposits of Siberia are not yet opened to any great extent. The industrial development of this region does not date back farther than about fifteen years. It was only then that modern machinery was introduced; and the subsequent improvement in the quality of Siberian manufactures has secured for them an extensive sale in Asia. The slow progress of these manufactures will be greatly accelerated as soon as cheaper and more rapid communication with Europe has become possible.

One of the principal considerations which recommend the construction of the Siberian Pacific Railroad is the remoteness and isolation of the Amur and Coast Provinces. At present there exist hardly any roads in this region. Communication is possible only on rivers which are navigable in spring and autumn, while in summer and winter intercourse is interrupted. In winter, sledges are used for travelling, while it is impossible to transport freight. What little trade there is, is almost exclusively in the hands of Americans and Chinese. The whole Russian population of Transbaikalia, the Amur Province, and the Coast Province, amounts at present to twenty thousand, while immigration from Manchuria is of considerable importance: therefore the Russian Government attempts to promote the Russian colonization of this region. The country is rich, but it is too remote to become a Russian colony until better communication with Transbaikalia has been established.

It must not be expected, that, even after the completion of the road, the settlement of Siberia will make as rapid strides as that of the American North-West. It is true, the Russian peasant is inclined to leave his home, and to look for a more prosperous life east of the Ural; but it must be remembered that no foreign immigration is possible, or would be allowed, the political aims of the Russian Empire being to Russianize the whole of its territory. As European Russia is not very populous compared to its area, a Siberian emigration will retard its progress in many respects, as its effect will be to produce a lack of the workers necessary to develop its resources.

The proposed railway, if completed, will be of importance not only for the development of the resources of Siberia, but also for the Eastern trade. At present a considerable amount of Chinese goods, among which tea is the most important, is sent overland. The cost of transportation is, of course, enormous, and will be greatly cheapened by the railroad. The present state of this trade may be seen from the following data given by the commissioner of Chinese customs at Tientsin. In 1887 this trade increased by 5,400,000 pounds, or nearly half as much again as in the year before; while the quantity of brick tea carried by the same route increased 7,300-000 pounds. This remarkable growth of the overland tea-trade was due to the unusual luxuriance of the Mongolian pastures, which, providing as they do the only sustenance for the enormous herds of dromedaries almost exclusively used as beasts of burden in these regions, exercise a very great influence on the prosperity of this branch of trade. It was owing to the failure of the grass-crop in 1885 that the transport of tea by that route fell so low, great numbers of dromedaries having died of starvation. The uncertainty of the grass-supply, and consequently of the means of transport, has led some Russian merchants to project a Decanville portable railway across the plains of Mongolia from Kalgan to Urga. The motive power would still be supplied by camels; but, whereas fifty thousand of these animals are now employed, it is calculated that ten thousand only would be required to do the same work on the railway, and that with these increased facilities the trade would in all probability be doubled. As in case of failure of the grass-supply a sufficient quantity could easily be brought from Siberia by the returning trains, the additional advantage would be gained of more certainty in the means of transport. The carriage of the tea over the mountainous district between Urga and Kiachta would still be effected by camels. An alternative scheme is a railway from Stretinsk to Veringukunsk, on the Amur. A fleet of seventy steamers is running on the Amur, and goods can be conveyed from Veringukunsk to Kiachta by one of the affluents of the Selenga River. Russian steamers would convey the tea from Hankow to the Amur. This route would be entirely under the control of Russia. It would



SKETCH-MAP OF THE RUSSIAN PACIFIC RAILROAD.

bring the whole profits of the trade into Russian hands, and offer greater financial facilities.

This route, although more expensive than the transport by sea through the Suez Canal, is preferred, as the quality of the tea thus transported is better.

One of the important considerations which induce the Russians to urge the building of the Pacific road is purely political. The Chinese boundary is at present almost unprotected, and it would be extremely difficult to concentrate an army of considerable strength anywhere east of Semipalatinsk. It is true that the boundary as far east as Manchuria is guarded by the best of protections, — a vast desert. Still greater weight is attributed to the connection with Vladivostok, the only harbor Russia possesses on the open ocean. Without the railroad, Vladivostok is of very little value, as the Coast Province is not able to furnish provisions for the garrison and fleet. It is hoped that its value will be greatly enhanced by the construction of the railway. A glance at the map will show that the latter follows for a long distance the boundary: therefore, in case of war with China, its safety appears very doubtful, and, indeed, it has been proposed by military authorities that it would be more advisable to build the road farther north.

From an engineering point of view, there are no serious obstacles to the building of the road, except the bridging of the large rivers of West Siberia, and the passing of the enormous swamps of that region, which would probably make the road far more costly than the Transcaspian Railway. There are no steep grades that would present serious difficulties.

The distances of the several sections of the line are given as follows: —

	Miles.
Tyumen to Tomsk	800
Tomsk to Irkutsk	1,050
Irkutsk to Stryelka	800
Stryelka to Usuri	1,000
Usuri to Vladivostok	300
Total	3,950

The cost of construction is estimated at from five to seven hundred million rubles. The whole distance from St. Petersburg to Vladivostok is estimated at six thousand miles; and the time necessary for accomplishing this distance, at from sixteen to seventeen days. To this must be added a few days for the journey from Japan and China to Vladivostok, and from St. Petersburg to western Europe. Thus the journey from eastern Asia to Europe might be made in from twenty to twenty-two days instead of from thirty to thirty-five days, which it takes steamers to run from China to England.

It seems improbable that the effect of this road upon the trade of the world will be as important as that of the American Pacific roads. The political condition of Siberia is not favorable to an energetic development of its resources and to an extensive immigration; and, the length of the road being so great, it is doubtful whether it would be able to divert the carrying-trade to any great extent from the steamers using the Suez Canal route.

SCIENTIFIC NEWS IN WASHINGTON.

Do Solids act Chemically upon Each Other? Mr. Spring's Experiments do not prove it. — The Transit of Venus and the Solar Parallax. — An Eighth Sternum Rib. — Measurements of Crania. — Adulteration of Condiments. — A New Fibre from the Stalk of the Cotton-Plant.

Chemical Action between Solids.

ONE of the most interesting papers read before the Washington Philosophical Society last spring was one by Mr. William Hallock on the formation of alloys at lower temperatures than the melting-points of either of their constituents. An abstract of the paper was published in *Science* (xi. No. 265) at the time. Mr. Spring, a distinguished chemist of Belgium, has been pursuing researches in the same field as Mr. Hallock, and has criticised some of the latter's work. At the last meeting of the Philosophical Society Mr. Hallock turned the tables on Mr. Spring by examining some experiments, a description of which had been published, to prove that chemical action takes place between solids.

Mr. Hallock began by mentioning one or two experiments illustrative of his theory of the formation of alloys, as referred to above. He placed potassium and sodium in contact, arranging a thermometer to register the temperature. As they united, the temperature fell 2°.4 C. below that of the room. A block of ice and one of rock-salt, the temperature of each being reduced 10° or 12° C. below the melting-point of the ice, when brought into contact, began immediately the formation of the solution of salt.

One of Mr. Spring's experiments to show chemical action between solids consisted of placing copper filings and sulphur in contact. The sulphur attacked the copper. Mr. Hallock doubted that this was a case of chemical action between solids, and prepared the following described experiment to satisfy himself. A piece of bright copper and a small mass of sulphur were placed near, but not in contact with each other. After a time the face of the copper was blackened by the sulphur. Thinking it barely possible that particles of copper might fly across the space between them, Mr. Hallock then varied the experiment as follows: The copper and sulphur were placed in a glass tube, with a wad of absorbent cotton an inch thick between them. The experiment was varied in several ways, in one case the tube being filled with dry air, in another the air exhausted, and in a third the tube being filled with oxygen, etc. In every case the copper was affected by the sulphur, although in some more than in others. Mr. Hallock's conclusion was that the chemical action did not take place between the copper and the sulphur *as a solid*, but that the active agent was the vapor of sulphur. In the same manner re-action took place between copper and mercuric chloride, the vapor of the latter passing through absorbent cotton.

Mr. Hallock does not deny that chemical action may take place between solids, — indeed, he is inclined to think that it does, — but he holds that Mr. Spring's experiments do not prove it.

The Solar Parallax.

Prof. William Harkness, a member of the United States commission to observe the transit of Venus, in a long paper read before the Philosophical Society at its last meeting, gave a very interesting description of the instruments used in observing the transit and in photographing the sun. Great labor, much of it very perplexing and occupying many weeks, was required to measure lenses used, and determine their focal distances, to ascertain the peculiarities of mirrors, etc., as preliminary to the observations. Professor Harkness described this work. About sixteen hundred photographs were secured, most of which have already been finished. The methods of reduction were also explained.

In the latter part of his paper, Professor Harkness spoke of the solar parallax and its related constants, introducing a series of intricate calculations which he has made to determine the latter. Among them may be mentioned the sun's distance from the earth as found by his calculations, 92,385,000 miles; as computed from data furnished by the transit of Venus, 92,521,000 miles; the moon's distance from the earth, 238,852.4 miles; the moon's mass, $\frac{1}{81.619}$; the velocity of light, 186,298.4 miles per second; sun's parallax, 8867″ ± .0012″.

An Eighth Sternum Rib.

At one of the meetings of the Anatomical Society during the late Medical Congress in Washington, Dr. Lamb of the Army Medical Museum spoke briefly of a singular phenomenon he had observed in his examination of human breast-bones. It was the occurrence, in a number of specimens, of an eighth rib, the cartilage that is usually found below the seventh rib being fully developed into a rib. Dr. Lamb first saw a specimen of this kind about ten years ago. While teaching, he had occasion to observe the subject he had before the class with great care, and was surprised on one occasion, on counting the ribs, to find that there were eight. He made no further investigation at the time, presuming that the phenomenon might be of comparatively frequent occurrence.

More recently Dr. Lamb has given the subject more attention, and now has in his own collection four specimens, while in the Army Medical Museum there are eight more. In all these cases the phenomenon occurs in negroes, but one additional specimen is that of an Indian.

Dr. Lamb has made a thorough search of anatomical literature

for references to the peculiarity mentioned. In the English books there is only a single incidental reference to it, and in that case the author does not say that he has ever seen a specimen. In German books there are two references, one of them being the one already mentioned by the English authority. The French anatomists do not mention it at all; and only one American, Allen, makes any reference to it. Among the anatomists attending the Medical Congress only two or three had seen specimens.

Dr. Billings, in a circular he has sent out to anatomists and others, has requested that information on the subject be sent to the Army Medical Museum.

The ethnological importance of Dr. Lamb's discovery has not yet been determined. If the eighth rib is found to occur more frequently in one race than in others, as the Washington specimens seem to point to the negro, the students of comparative anatomy may yet draw interesting deductions from that fact.

Measurements of Crania.

Under the direction of Dr. Matthews and Mr. Tracey, of the Army Medical Museum, a series of measurements of skulls is being made. About one hundred skulls, representing different nationalities, were selected from the three thousand which constitute the museum's collection, and a series of sixty linear measurements are made upon these in addition to measurements of certain angles and the ascertainment of the capacity of each skull. These measurements are mostly made upon lines of former ones, in order to preserve a uniformity of data, although many of them are considered of little or no value. A few new measurements are made, which, it is believed, will prove important. The measurements, together with descriptions of the skulls, will be published as a part of the catalogue of the Army Medical Museum which is contemplated.

It is not expected that any important conclusions will be reached as a result of the work above described. No fact has been better established than that the size of the brain or the shape of the skull has nothing to do with the mental capacity of the person. The causes of difference of intelligence must be sought elsewhere. It is possible that the measurements, if carried far enough, may tend to the establishment of distinct types of crania, and aid in their classification.

The Army Medical Museum collection of crania is in many respects a very interesting one. The number of Eskimo skulls is the largest yet made, and the department is especially rich in other aboriginal American crania. A recent accession of Peruvian skulls contains some curious specimens, especially of deformities. These were generally caused by bandaging and the binding of boards to the head, and a great variety of shapes was produced. Nothing is known as to the significance of these deformities. Whether they were distinguishing marks of different ranks in society or of the special rank of the individual, or were simply a custom, is a mystery.

Adulteration of Condiments.

The microscopist of the Department of Agriculture, Prof. Thomas Taylor, has begun an examination of the condiments of commerce for the purpose of ascertaining which of them are adulterated, the methods and extent of the adulteration, and of discovering methods by which the consumer may detect impure articles.

The first article treated was pepper, and the method of the investigation is here briefly described. A section of a pepper-corn is placed under a microscope, and magnified one hundred and fifty diameters. Its appearance is carefully noted and photographed, and a drawing in colors is made, showing exactly how it looks. The pure powder of pepper-corns is then treated in the same way, and, from a comparison of the image of this with that of the section, the changes caused by grinding may be noted. The next step was to examine specimens of the pepper of commerce to ascertain if it presented the same appearance as the pure pepper already photographed and drawn. In a majority of cases it did not, the differences being so striking as to mark it as an entirely different article.

Professor Taylor has ascertained that the substance used in adulterating pepper is the seed or stone of the olive. These are obtained in large quantities from the olive-oil factories, and ground up with the pepper-corns, the extent of the adulteration being in some cases as great as fifty per cent.

No method of popularly detecting adulteration of pepper has yet been found. In bulk the pure pepper is darker in color than that to which olive-seeds have been added; but the difference is so slight that no person, unless possessed of a sample to compare with, would be able to discover any difference.

A New Fibre from the Stalk of the Cotton-Plant.

A manufacturing firm in New York has sent to the Department of Agriculture specimens of a new fibre they are making from the stalk of the cotton-plant. The samples received strongly resemble hemp, and seem to be adapted to all the uses that hemp is put to. A few fibres of it twisted together in the hand show remarkable tensile strength, although no exact comparative tests with other fibres have yet been made. A collection of the fibres of hemp, flax, jute, ramie, etc., from all parts of the world is being made by the department, and a new instrument has been invented by which it is expected that the tensile strength of each will be ascertained with great accuracy.

If the cotton-plant turns out to furnish as valuable a fibre as now seems possible, an important new source of profit will be afforded the cotton-planters of the Southern States upon their crops.

HEALTH MATTERS.

Corrosive Sublimate as a Disinfectant.

AN exceedingly valuable contribution to the subject of disinfection has been made by Dr. W. B. Hills of Cambridge, Mass., in a paper presented by him to the Massachusetts Medical Society. His paper is entitled 'The Value of Corrosive Sublimate as a Practical Disinfectant.'

He criticises the work and report of the committee on disinfectants of the American Public Health Association, which, since its publication in 1885, has been the guide of most of the boards of health in the United States. He says of it, "An examination of the report of this committee fails, however, to bring to light the slightest particle of evidence upon which such a recommendation could have been based. The statements made relative to corrosive sublimate are very contradictory and confusing; the biological tests recorded are few in number and very unsatisfactory; and the report, as a whole, shows evidence of hasty preparation, and is not at all creditable to the committee."

He reviews that portion of the committee's report which treats of corrosive sublimate and its action, and puts the committee on its defence. He does not deal in generalities which cannot be met, but particularizes in such a manner, that, if wrong, his mistakes can and should be pointed out; while if, on the other hand, he is correct, his conclusion should be accepted, and those of the committee should be changed to be in accord therewith. The general result of his observations and experiments is summed up in the following paragraphs: —

"Corrosive sublimate, in a word, though a very efficient disinfectant as meaured by its power to destroy germs, is limited in its applications. It can be used for the disinfection of furniture and other articles made of wood or porcelain, or even metal, if varnished, the floors and walls of rooms, such parts of ships as can be reached with solutions, the hands and the surface of the body, and clothing and bed-linen if not soiled with discharges; in other words, for the disinfection of surfaces which are not themselves injured by contact with it, or surfaces which do not contain material of such a character as to destroy its efficiency. Its use for these purposes is, however, very much restricted, because we have no means of disposing of it, except through lead pipes.

"Objections have been made to it because of its poisonous character. The danger of poisoning, however, is very slight. The solutions employed are very dilute, and its taste is sufficiently disagreeable to attract attention before an amount sufficient to do any injury has been taken. If the solutions are colored, the danger of mistakes is much lessened. The same objection may be made with equal reason against all substances which we now recognize as disinfectants. Care is necessary in the employment of all of them,

and those intrusted with their use should be informed of their properties, that all necessary precautions may be taken.

"There is, however, one process of disinfection with corrosive sublimate to which this objection may with some reason be made. I refer to its use for the disinfection of streets, for which purpose it has been employed by the Board of Health of Boston for the past two years or more. If its use for this purpose is continued, the time cannot be far distant when the beds of the streets will become saturated with various compounds of mercury. All of these, so far as we have any knowledge of them, are violent poisons. Is any danger to be apprehended from continually inhaling or swallowing, month after month, dust loaded with compounds of mercury? This is a question deserving serious consideration at the hands of the Board of Health. While not claiming that the process is positively a dangerous one, I believe it is one which involves some risks, and one which it is advisable, therefore, to discontinue."

DEPENDENT CHILDREN. — We commend to our readers a paper presented to the Prison Congress by Mr. C. H. Reeve of Plymouth, Ind., entitled 'Dependent Children.' He says, "The mass of dependent children is largely made up of foundlings, illegitimates, children abandoned by worthless parents, orphans of the very poor, with a few better born who become waifs from various causes. In the cases of nearly all of them except the last, there is more or less mental deficiency, or deformity in the brain substance, or the conformation or arrangement of brain ganglia. Statute law makes marriage a civil contract, — a matter of dollars and cents. No matter who comes for a marriage permit, — the strong or the weak-minded; the sound and healthy or the deformed and constitutionally diseased; the millionnaire or the hereditary pauper; the moral and orderly, or the vicious and confirmed criminal; the progenitor of statesmen or of idiots; the sane, or the hereditary insane if favored with a lucid interval; the temperate or the besotted, — all are given a permit alike. The revenue is collected, the ceremony authorized, the record made, and this civil contract is fully completed by sanction of law. If a man wants to run a locomotive-engine, or practise medicine (elsewhere than in the United States), or plead in the courts, or stand in the sacred desk and talk theology, or teach a school, or run a pilot-boat, or even to secure a petty clerkship under government, he must submit to a rigid examination as to his fitness for the position and its duties, and be able to pass one. But one comes forward to get a permit to enter into a contract that places him under obligations, and demands of him duties, that are the most important, the most responsible, the most sacred, that can be assumed anywhere between the cradle and the grave, that vitally affect the bodies social and politic as well as corporal, now existing and hereafter to exist, directly and indirectly, not a word is said. All are licensed." In his paper he criticises the Church in the following language: "It regards marriage as a holy, sacramental covenant. By permission of law, its ministers ceremonially aid the parties in making this holy covenant, which at the same time involves the statutory civil contract. It makes little or no inquiry as to the candidates (one organization may as to belief in a creed). It looks only for a license, and the fee in prospect. Even in the shadow of the prison-wall and of the gallows, its ministers, in sacerdotal robes, have united criminals. Thus is it sanctioned by the Church!" He believes that human foresight and legal provisions can prevent these marriages.

BALDNESS. — We have from time to time given our readers the views held by the medical profession and the laity as to the causes of baldness. The view which has seemed to us as being the best supported by both facts and theory is that baldness is especially liable to follow the wearing of a tight-fitting hat, the band of which constricts the blood-vessels, and thus diminishes the blood-supply to the scalp. In the *Popular Science Monthly* is a communication from a writer who has spent a considerable time in India, which controverts this explanation of the cause of baldness. The Parsees are compelled to keep the head covered during the day by a high hat, which is so tight as to crease the scalp, and, the writer thinks, possibly the skull, and at night by a skull-cap. He has never seen or heard of one of them being bald.

TREATMENT OF YELLOW-FEVER. — Regarding the treatment of this disease, Dr. George M. Sternberg, U.S.A., in the *Therapeutic Gazette*, Aug. 15, reports the favorable results obtained in a series of twelve cases treated on the alkaline plan. His recent researches in Havana have led him to think it very probable that in yellow-fever, as in cholera, the specific micro-organism causing the disease is located in the alimentary canal. While this is not proved, it is demonstrated, that, as a rule, no micro-organism capable of development in the culture-media usually employed by bacteriologists is present in the blood or tissues of those recently dead from yellow-fever. This view naturally suggests intestinal antisepsis as a mode of treatment. It is well known that in yellow-fever the urine and the vomited matters are highly acid. He has also found the intestinal contents to have usually a more or less decided acid re-action. A microbe, therefore, capable of multiplying in the stomach and intestine in this disease must be able to grow in an acid medium. But aside from this theoretical reason for prescribing alkalies, the highly acid condition of the secretions furnishes an indication for such a treatment, and the writer has long desired an opportunity to see a thorough trial of a decidedly alkaline treatment. These considerations induced him, during his recent visit to Havana, to propose a formula, which was adopted by Dr. Raphael Weiss, house physician at the Garcini Hospital, and he has just received from him a record of twelve cases treated by the director of the hospital, Dr. Francis Cabera, and himself. They all recovered, and he adds that every case so far treated at the Garcini by that method has recovered. While these twelve cases were being treated, and a little before, eight cases were treated in the same institution by other methods, and five of the eight died.

DIPHTHERIA CARRIED BY TURKEYS. — Some time ago we reported several cases of diphtheria which had been contracted from a turkey. The following case, which is taken from the *British Medical Journal*, is another contribution to this subject: "A fowl with diphtheria was brought to the house of a veterinary surgeon on April 24, and died on the 29th. The feeding and nursing of the bird devolved on a lad, aged fourteen, who was assisted by his brother, aged five. On the evening of May 11 the writer was called to see the little boy of five, who had been poorly for a day or two. He had enlarged cervical glands on the left side, which had come on rapidly. He was a delicate little fellow, with fair hair and anæmic aspect. The temperature was 103° F.; pulse, between 120 and 130. The fauces were more or less covered with diphtheritic membrane, the left tonsil more especially. Under the administration of biniodide of mercury and iron, the throat symptoms cleared up, and the child made a good recovery. On the day after this case was first seen, the boy who fed the fowl was very feverish, and had similar patches over his fauces, but not to the same extent as his brother. His throat was painted with boroglyceride. A sister, aged nine, had also a similar explosion on the fauces. Bark and acid and boroglyceride was the treatment. On the 18th the mother, who had nursed them, was attacked, and was similarly treated. They were all kept well up with beef-tea and stimulants."

CIGARETTE-SMOKING. — Dr. W. L. Dudley has been conducting some experiments with cigarettes in order to determine their effect upon smokers. His conclusions are, (1) that carbonic oxide is the most poisonous constituent of tobacco-smoke; (2) that more injury results from cigarette than cigar or pipe smoking, because, as a rule, the smoke of the former is inhaled; (3) that cigarette-smoking without inhaling is no more injurious than pipe or cigar smoking; (4) that the smoke of a cigar or pipe, if inhaled, is as injurious as cigarette-smoke inhaled; and (5) that the smoke from a Turkish pipe, if inhaled, is as injurious as that of a cigarette inhaled.

ELECTRICAL SCIENCE.

Electric Lighting in America.

THE following is an abstract of Prof. George Forbes's paper on the above subject, read at the recent meeting of the British Association. Professor Forbes has been in the United States, and has paid especial attention to the alternating-current system of electrical distribution. He first sketched the rapid advance of electric lighting in the United States as compared with its slow progress in England, — a result which he considered partly due to the acts of

Parliament regulating electric distribution in the latter country. The rapid progress in this country he ascribed partly to the fact that capitalists here have sufficient technical knowledge to cause them to take up and actively develop new scientific discoveries. Professor Forbes called attention to the fact that storage-batteries have not found favor in America, all of the lighting being done directly from the machines. The objection against depending on moving machinery entirely is the possibility of a break-down putting a district in darkness, but experience has shown this fear to be groundless. The Edison station in Pearl Street, New York, has only stopped once in seven years, and it has been working night and day.

The greater part of the author's paper was spent in describing the Westinghouse alternating-current system. At the end of last year this company had 153,285 incandescent lamps installed, fed from 152 stations: at present the number of lamps in use exceeds 300,000. The greatest trouble the Westinghouse people have had to encounter has been from the short-circuiting of their overhead mains from falling telegraph and telephone wires. This difficulty is overcome by subdividing their dynamo power and the circuits. Some of the stations are worked by natural gas, the fire under the boilers being automatically regulated so that one man can attend to a station of 1,000-horse power. At first the hydrogen in the gas attacks the iron of the boilers, but after a time the metal gets into a condition in which no further deterioration takes place. Instead of using a small number of large engines, it has been found economical to drive the dynamos from a number of comparatively small-power, high-speed engines. This subdivision has the additional advantage of guarding against a break-down. A commendable feature of practice in America is the adherence to a few types of dynamos and converters. This allows them to be made cheaply; and all of the parts are interchangeable, so any damage can be repaired quickly and with little cost. The following tables give particulars of the construction of converters and dynamos: —

Dynamos.

	I.	II.	III.
Number of lamps	650	1,300	2,600
Current	35	65	130
Armature resistance	0.76	0 37	·95
Field resistance	14 5	7.0	3.6
Pounds of wire in armature	17	30	60
Pounds of wire in field	420	—	—
Total weight	4,800	9,000	—
Volts	1,050	1,050	1,050
Revolutions per minute	1,600	1,000	1,000

Converters.

	1	2	4	6	8
Number of lights	5	10	20	30	40
B. and S. gauge, primary	25	22	19	17	16
B. and S. gauge, secondary	11	8	8	8	7
No. turns of primary	900	700	560	480	400
No. turns of secondary	45	35	28	24	20
Resistance of primary	43	21 9	9.9	7	5
Resistance of secondary	0 04	.043	0.0197	0.0176	0.0107
Pounds weight finished	50	60	95	-	160

Thickness of iron plate used in construction	0.006 in. to 0 0065 in.
Thickness of paper insulation	0.0025 in.
Number of plates in No. 8 converter	1,350

Great care is taken in the insulation of the dynamos and converters. The insulating materials used are mica, fibre, and a superior kind of varnish made of copal varnish and linseed-oil. The period of alternation used is 8,000 complete alternations per minute, and the efficiency of transformers is very high, even when not fully loaded. Tests have been made showing an efficiency as high as ninety-five per cent at half-load. The transformers are fixed outside the houses, either against the walls or on posts. The total efficiency from the engine to the lamp is very high, and 600 watts of energy have been supplied to the consumer for every brake horse-power (746 watts) at the engine.

Electric Lamps for Mines.

There are very few applications of electricity in which England leads this country, but one of them is in portable batteries and lamps for mining-work. These are being rapidly and successfully introduced in the collieries of England and Wales; and the following are the details of the most successful of them, taken from a paper of Mr. Nicholas Watts, read before the British Association at its last meeting: —

The Swan Lamp. — Secondary battery: four cells grouped together in a block of gutta-percha, which is enclosed in a wooden case. Luminosity, 1 to 1½ candles for ten hours' duration; weight, 7 pounds; price, $6.25; cost of maintenance, 7 cents per week. In extensive use in South Wales.

The Schanschieff Lamp. — Single-fluid primary battery: four zinc-carbon cells in a solution of basic sulphate of mercury, about 36 per cent of the salt being in solution. The solution is sold at $1 per gallon, and 89 cents is allowed for the same quantity of spent liquid with its solid residue and free mercury precipitated by the cells. Luminosity (with reflector), 2 to 3 candles for nine hours' duration; weight, about 5 pounds; price, $7.50; cost of maintenance, 7½ cents per week. Tested at Cannock Chase, Mardy, Merthyr, and elsewhere.

The Pitkin Lamp. — Secondary battery: four cells. Luminosity (with reflector), 4 to 5 candles for ten hours' duration. The lamp is fitted with a switch and resistance to regulate the electro-motive force. Weight, 8 pounds; price, $10.50. Used at Llwynypia, Ocean Colliery, Trevicky, and elsewhere.

The Walker Lamp. — Primary battery: three carbon-zinc cells in a strong brass cylinder attached to an outer case of brass or copper. The fluid is a mixture of bichromate of potash, nitric acid, and sulphuric acid. Luminosity (with reflector), sufficient to enable newspaper-print to be read at a distance of 12 feet; duration, ten hours; weight, 7 pounds; price, $8; cost of maintenance, 14 cents per week.

The Portable Electric Syndicate Lamp. — Secondary battery. Luminosity (without reflector), 1½ candles for 1½ hours' duration; weight, 4½ pounds; price, $5. The lamp is fitted with an automatic arrangement, whereby, if an outer casing of toughened glass be broken, the current is cut off to prevent explosion of fire-damp.

The Vaughton Lamp. — Secondary battery. The plates are wedged tightly in the cell, making the battery so compact that it may be subjected to much rough usage without injury. Weight, 5 pounds; working cost, 14 cents per week; price, $6 to $7.

The advantages of these lamps are, that they do not consume or vitiate the air, they give a steady and more powerful light than the ordinary miner's lamp, and the danger of igniting fire-damp is reduced to a minimum. With the rapid improvements in secondary and primary batteries, they will soon come into universal use.

ELECTRIC ABSORPTION IN DIELECTRICS. — A. Wullner, in *Wiedermann's Annalen* (xxxiii. p. 19), has studied the effect of time on the potential of a charged condenser. It is well known, that, when the specific inductive capacity of a substance is obtained by determining the capacity of a condenser of which it forms the dielectric, different values are found, according to the time that elapses between the charge and the measurement. Wullner has attempted to find some law that governs this 'absorption' of electricity by the dielectric. His method of experiment consisted in observing, by means of an electrometer, the variations of potential of a condenser which has received a determinate charge; the first readings being taken at intervals of twenty seconds, the rest at intervals of from one to two minutes. He experimented on a glass Leyden jar, and on disks of glass, ebonite, gum-lac, paraffine, sulphur, and mica. The results are, that the potential cor-

responding to a determinate charge diminishes rapidly during the first few seconds, and then varies almost as the terms of a feebly convergent geometrical progression. The law of variation varies with the substance, and is not always the same for disks of the same substance. The values of the specific inductive capacity obtained after as short a charge as possible are different for substances which are apparently identical, but are always sensibly the same disk.

BOOK-REVIEWS.

The Law of Equivalents in its Relation to Political and Social Ethics. By EDWARD PAYSON. Boston and New York, Houghton, Mifflin, & Co. 12°. $2.

THE title of this book is forbidding, and as inappropriate as it is forbidding. The author's 'Law of Equivalents,' which he announces in such a formal manner, is nothing but the familiar truth that if we wish to attain any end, no matter what, we must use the means appropriate to that end; and that if we use the wrong means, we shall not attain the end, even with the greatest exertions. The truth is one of great practical importance; but its announcement in such a form, and as if it was a new discovery, is not fitted to attract the reader. The author's style, too, though generally clear, is too dithyrambic for a philosophical work, passages like the following being not infrequent: "Family — the very word itself is redolent of sweetness. It is a holy, yea, a wholly divine word. It fairly outtops every other word in the language. It is not so much an apothegm as a treatise, not so much a treatise as a text, not so much a text as a sermon, not so much a sermon as a poem," with much more of the same sort. The defects of style are aggravated by the too frequent use of interrogative sentences where declaratory ones would be more appropriate. But when these deductions are made, there is much in the book that is good, and may prove useful. Mr. Payson's special concern is moral improvement; and he insists that men are prone, and Americans especially so, to use the wrong means for this purpose; as, for instance, when they try to make men good by legislation, or to make them learned by simply establishing libraries and schoolhouses. In such cases, he says, we do not offer nature the right equivalent, we do not use the right means to reach the desired end. He rightly insists, also, on the importance of time as a condition of moral and intellectual improvement, reminding us that such improvement must necessarily be slow, and that changes in the beliefs and practices of a nation can only take place when the progress of events has prepared the way. He finds in the American people a tendency to look for some great spiritual movement as wonderful in its way as the great material advance of the past hundred years, and resulting in the regeneration of society; and he maintains that such expectations are unwarranted. Mr. Payson's views are in the main in accord with those of most judicious thinkers; but his work would have been more interesting and more useful if it had been written in a soberer and more philosophical style.

Lectures on Geography. By Lieut.-Gen. R. STRACHEY. London and New York, Macmillan. 12°. $1.25.

THE University of Cambridge, about a year ago, accepted the proposal of the Royal Geographical Society to provide a lecturer on geography with the aid of funds to be supplied by that society. As an introduction to the lectures on this science, new to the Cambridge University, the council of the society was requested to arrange a course of lectures illustrative of the general character and scope of the instruction in geography suitable for a university course. In compliance with this request, a course of four lectures was delivered by Gen. R. Strachey, president of the Royal Geographical Society, which have now been published in the form of a book. Strachey designates as the aim of geographical science, to investigate and delineate the various features of the earth; to study the distribution of land and sea, the configuration and relief of the surface, position on the globe, and so forth, — facts which determine the existing conditions of various parts of the earth, or which indicate former conditions; and to ascertain the relations that exist between those features and all that is observed on the earth. On account of this point of view, the book is especially valuable. Since the importance of physical geography has become recognized, the tendency has been to underestimate the value of topography, in the same way in which systematic botany and zoölogy became neglected when biology became the favorite study. Strachey first discusses the astronomical relations of the earth, its form and magnitude, and the history of its measurement. Appended to this is a chapter on map-making, in which he dwells upon Tissot's projections, the principles of which are unfortunately not yet sufficiently known either in England or in America. After a brief historical sketch of the development of our geographical knowledge, he passes to a brief review of physical geography and to considering the relations of vegetable and animal life to terrestrial features. He concludes with some remarks on the influence of geographical conditions on man. The book is clearly written, and we hope it will be widely read, as the author, by his terse and interesting treatment of the subject, impresses the reader with the importance of disseminating and promoting the science of geography.

Les Formes du Terrain. By G. DE LA NOË. Paris, Imprimerie Nationale. 4°.

LIEUT.-COL. D. DE LA NOË, of the geographical service of the French army, has prepared, with the collaboration of M. Emm. de Margerie, an elaborate treatise on the forms of the ground. It is of both geological and geographical interest. Under the first heading we should place the argument for the derivation of land-relief by sub-aerial denudation, the evidence for the origin of valleys by stream-erosion essentially independent of fractures, and other discussion of processes; under the latter heading we should include the description of plateaus, valleys, and other topographic elements, in connection with the conditions of their origin and development. The deductive considerations are fully supplemented with illustrations in a large volume of plates, many of which are reproductions of excellent topographic maps, chiefly of French localities. The relation of the activity of streams to their controlling base-level receives much more explicit attention than is common with European authors, and the sections in which this large problem is discussed are very profitable reading. The same may be said of the explanation of cross-valleys such as occur in the Jura Mountains. They are shown to traverse the anticlinal ridges where the structural arch, if complete, would be lowest. The list of authors quoted is remarkably full, and American writers receive a large share of notice.

Leibniz's New Essays concerning the Human Understanding. By JOHN DEWEY. Chicago, S. C. Griggs & Co. 16°. $1.25.

THIS work is the latest issue in the series of 'German Philosophical Classics for English Readers,' now publishing under the editorship of Prof. G. S. Morris. The plan of the series does not contemplate the complete exposition of any philosopher's views, but only of some one of his masterpieces. This plan has some advantages, but also some disadvantages; and these latter are specially prominent in the case of Leibniz, whose mental activity was so multifarious. He was by no means a mere philosopher, and even in philosophy the 'New Essays' present but a small portion of his views. Professor Dewey has seen this, and endeavors, so far as his space permits, to remedy it. He remarks that "Leibniz, like every great man, absorbed into himself the various thoughts of his time, and in absorbing transformed them. He brought into a focus of brilliancy the diffused lights of truth shining here and there. He summed up in a pregnant and comprehensive category the scattered principles of his age." Some of us will regard this encomium as a little extravagant, yet, at all events, it shows what Leibniz attempted to do, and hence Professor Dewey has found it necessary to enlarge his plan a little, and give some account of those doctrines of his author not presented in the 'New Essays.' He has, we think, given too much attention to the theories of monads, and pre-established harmony, which are products of imagination rather than of reason; while, on the other hand, he has taken no notice of Leibniz's attempt to reconcile Infinite Goodness with the existence of evil. In dealing with the 'New Essays' themselves, which were written in reply to Locke, Professor Dewey has to present the views of both philosophers to a considerable extent; and in doing so he clearly reveals his own philosophical standpoint. He is a disciple of Kant and Hegel, and looks upon Leibniz as their forerunner, while Locke's work is in his eyes little

better than a tissue of falsehood. Some of us who have a higher opinion of Locke may think that Professor Dewey has not always presented the English philosopher's views correctly, though we are sure he has not done him any intentional injustice. He shows, too, a strong desire to connect the views of Leibniz with his own, and, in trying to do this, sometimes gives an interpretation that seems a little strained. But, if due allowance is made for the author's philosophical standpoint, the reader will obtain from this book a pretty good idea of most of Leibniz's doctrines in their relation to those of Locke on the one hand, and of the later German thinkers on the other. This series of expositions will, we think, be very useful in giving to purely English readers a more intimate acquaintance with the products of German thought.

First French Course. By C. A. CHARDENAL. Boston, Allyn & Bacon. 16°.

AFTER a brief introduction on the phonetics of French, the author proceeds at once to give a systematic series of exercises on the elements and syntax of the language, keeping throughout in view the practical end to teach the pupil thoroughly the use of the French language. The French-English and English-French exercises are well selected, and the lessons so arranged that the most general and most fundamental laws of the French language are given first, after which details are taught. In an appendix a tabulated review of forms and rules is given, and the book concludes with a brief series of extracts, to which a vocabulary is added.

Teachers' Manual Series. Nos. 7, 8, 9, 10. New York and Chicago, E. L. Kellogg & Co. 15 cents each.

THE last four numbers of this series, which have recently been issued, contain material that will prove very suggestive to teachers. No. 7 is a reprint of Bishop Huntington's memorable address on 'Unconscious Teaching,' that was delivered many years ago, and at that time excited great interest. He justly emphasizes the fact that the teacher's character and behavior influence in a great degree the development of the pupil, and that the most careful attention should be paid to this fact. No. 8, written by James L. Hughes, is entitled 'How to keep Order;' and in this the author endeavors to show that keeping order is a necessary means of training the character of the pupil, as order teaches that conscious deviation from the right, and that conscious violation of any rule, is a wrong, no matter how important or unimportant the rule be. The latter half of the book is occupied by a discussion of mistakes of the teacher which promote disorder, and thus the best instruction as to how to keep order is given. In No. 9, by Rev. R. H. Quick, 'How to train the Memory,' the author gives the results of his experience, which are, that attention, arrangement, and association are the proper means of training the memory. No. 10 is a description of 'Froebel's Kindergarten Gifts,' by H. Hoffmann. These gifts are well known, and the author sets forth very clearly the best methods of using them for training the child's senses and power of observation.

Francis Bacon. By JOHN NICHOL. Part I. Bacon's Life. Philadelphia, Lippincott. 16°. $1.25.

THE present sketch of Bacon's life belongs to the series of Philosophical Classics, edited by William Knight. The author has endeavored to record impartially the events which led so many writers to condemn the character of Bacon. He accepts neither the views held by Spedding, who is bent on believing the best, nor those of Abbott, who does not find any thing to commend in Bacon's career. His views agree with those propounded by Gardiner. The author rightly emphasizes the necessity of carefully considering the circumstances of the age in which Bacon lived, in forming an opinion of his actions. He dwells upon the fact that during his life he took the unpopular side of several questions, and thus proves that he was not so mean as to sacrifice every thing to the promotion of his own interest. The author's treatment of the trial of Essex is of special interest, and we think he has well succeeded in explaining how Bacon came to take a prominent part in those events, and that his actions were in accordance with views expressed in his letters to Essex. On the other hand, the author does not try to excuse his great faults and weaknesses. In a clear introduction, Bacon's age and surroundings are described, and next his life until the death of Elizabeth is treated. His relation to James, his gradual rise and sudden downfall, form the following chapters of the book, which concludes with a sketch of his last years. The second volume will contain a *résumé* of his philosophy.

How to teach Manners in the School-room. By Mrs. JULIA M. DEWEY. (The Reading Circle Library, No. 7.) New York and Chicago, E. L. Kellogg & Co. 16°.

WE fully agree with the authoress of the present little volume, that the teacher ought to be careful to teach the pupils good manners, but we disagree in every other respect with her views. It seems that her prime object in teaching good manners is to make children contemplate in all their actions, "What will people say if they see me doing this or that?" — a principle that can hardly be considered as improving the moral standard of the pupils who are subjected to it. It is true, as the authoress says in the introduction, that true courtesy implies strict honor, self-possession, forbearance, and refined feeling; but these qualities will hardly be developed by such teaching as forms the greater part of Mrs. Dewey's suggestions. We cannot agree with principles similar to the following, which has been taken at random from the book (p. 55): "Why should our behavior on the street be good? Because many people see us there, and notice if it is not good."

A Quiz Manual of the Theory and Practice of Teaching. By ALBERT P. SOUTHWICK. New York and Chicago, E. L. Kellogg & Co. 16°.

IN a long series of questions the author places before the teacher many important problems regarding the method of teaching. The first part of the book contains questions, while the second contains answers to these questions. The subject is divided into numerous divisions, according to the subject of teaching; and a study of the work will prove a valuable incentive to improving the methods applied in teaching, as it suggests many ideas to the teacher, a great number of which he will accept, and use for the benefit of his pupils. In a general introduction the author treats of the general theory of education. This is followed by notes on the theory of teaching reading, arithmetic, natural history, language and grammar, composition, rhetoric, etymology, literature, and so on through the whole range of subjects taught in our schools. As an appendix, some notes on manual training are given.

NOTES AND NEWS.

THE editor and publisher of the *International Ethnographical Archive* have issued, on the occasion of the Seventh International Congress of Americanists, a supplement to their journal, entitled 'Contributions to the Ethnology of America.' This interesting pamphlet contains extracts from the journal, and one of the beautiful plates that are to accompany Stoll's account of the ethnology of Guatemala. The pamphlet contains one American and four German contributions. The journal continues to be one of the most magnificent scientific periodicals, and it bids fair to become one of the principal sources of information for the study of ethnology, more particularly for that of human inventions.

— At a meeting of the council of the Anthropological Society of Washington it was voted to continue the publication of the quarterly journal, *The American Anthropologist.* This journal publishes in full the most important papers read at the meetings of the society.

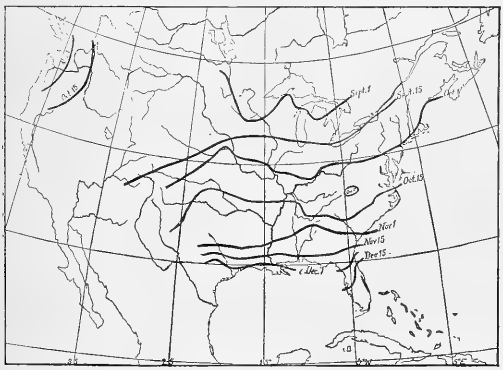
— In the publication in *Science* a few weeks ago (xii. No. 295) of the classification of soils, which formed a part of the annual report of Major Powell, director of the United States Geological Survey, one class was inadvertently omitted, — that of the playa soils; i.e., those formed by the wash of rains and the evaporation of intermittent bodies of water that have no overflow.

— The trustees of the Hoagland Laboratory, Brooklyn, announce the completion of the laboratory, and its equipment for work. Special facilities are offered to those who desire to prosecute original research. For this purpose private laboratories have been provided, and arrangements are now being made for the purchase of a library which shall contain all the literature necessary for reference in the departments of bacteriology, physiology, and pathology.

Owing to the absence in the South of Dr. George M. Sternberg, the director, in the further prosecution of his investigations into the cause of yellow-fever under orders from the President of the United States, the course of lectures on bacteriology, already announced, will be postponed until his return. The trustees further announce that the services of George T. Kemp, Ph.D., Johns Hopkins University, have been obtained as associate in bacteriology and physiology, and that with his assistance, and under the direction of Dr. Sternberg, practical instruction in bacteriology will be given during the winter and spring.

— Capt. C. E. Dutton has been placed in charge of the hydrographic work of the investigation of the problem of reclaiming the arid lands of the West. He will divide the territory into districts, but work will be done in only a few of them under the present appropriation. Those selected in which to begin are the basins of the South Platte, Arkansas, Colorado, Gila, and Humboldt Rivers. The parties will be sent into the field immediately.

— The *Monthly Weather Review* for July contains an interesting map showing the average date of first killing frost in the United States. A reduction of the map has been reproduced here. The chart has been prepared solely from observations made at voluntary observers' stations. The data from the regular signal-service stations were not incorporated, because it is believed that observations as to the occurrence of frost are made in the country with greater opportunities for accuracy as to earliest date and extent of damage



than in large cities, where signal-service stations are generally located. In the preparation of the chart, diligent effort has been made to secure reliable information as to killing frosts only, especially those frosts which were injurious to vegetables and other crops. It is probable that in some cases the first frost reported may have been 'light' instead of 'killing.' It was found that killing frost occurred throughout the year along the northern boundary of the United States north of Dakota and Minnesota. In California killing frosts are very unusual in the extreme east and north-east portions: throughout the western portion of the State, light frosts in winter, appearing about the middle of December and continuing not later than February, are not unusual, but rarely injure even delicate plants. The observations from which deductions have been made vary in length of records from two to forty-nine years, thirty-six stations having records of fifteen years or more. The total number of stations involved in the work is four hundred and thirty-two. It appears from the tabulated statement that the average error of the earliest date will be about eighteen days. This necessitates the continuation of the observations over a very long period in order to reach a probable error not exceeding a few days, and it may therefore be assumed that a final construction will show the lines to run somewhat differently from those represented here. The collation and discussion of these observations are of great importance to the farmer.

— The Western Society of Naturalists will hold its first annual meeting in the buildings of the Illinois State University at Champaign, Ill., Wednesday and Thursday, Oct. 24 and 25, 1888. The president of the society, Dr. Stephen A Forbes, will deliver the presidential address on Wednesday evening. Discussions on the methods of teaching natural history will form one of the principal features of the programme of the meeting. Prof. J. S. Kingsley of Bloomington, Ind., is secretary of the society.

— In the 'Report of the Kentucky Geological Survey for 1888,' Dr. A. H. Loughbridge gives a full account of the geological and economic features of the Jackson Purchase Region. After a description of the topography and geology, the author discusses minerals and water-supply very fully, and gives detailed statements of the agricultural resources. This part of the book is of special value; and the author's descriptions of the physiognomy of the uplands and lowlands, and their respective vegetation, is of great practical and scientific interest. In a short chapter some of the most interesting antiquities of this region are described. The second part of the volume contains descriptions of the countries forming the Jackson Purchase. The results of a deep boring at Paducah are very important, as they prove the existence of a great fault in the paleozoic strata of that region. The volume is accompanied by three good maps, showing the geology and elevations, the agricultural features, and deposition of gravel-beds. The topographic maps of Kentucky made by the Geological Survey under the direction of J. R. Hoeing are among the best made by any of the State surveys.

— D. Charnay, during his recent journeys in Central America, explored a certain group of ruins which he claims to have discovered, and which he named 'Lorillard City.' According to a communication of Dr. G. Brühl, these ruins were discovered in 1881 by Professor Rockstroh, who requested Maudslay to make a survey. According to Rockstroh, their proper name is 'Menché tenamit,' the city of Menché, the latter word being the name of a chief.

— The long series of systematical meteorological observations made in Bavaria have yielded many important results. Recently C. Lang has examined the records of the variations of underground water in their relation to precipitation, and to fires caused by lightning in the 'German Meteorological Annual for 1887.' He finds that the height of the water found under ground varies according to the amount of precipitation. This influence is somewhat obscured by the fact that the increase corresponding to a certain increase of precipitation is greater in the spring and autumn than it is in summer. It is generally assumed that the danger of damage done by lightning has steadily increased, but Lang shows that this view is not correct. When he plotted the number of recorded fires caused by lightning, together with that of the variation of underground water, he found that the maximum of one curve exactly coincided with the minimum of the other. This fact is easily explained. Damp ground is a good conductor, and facilitates the gradual discharge of electricity, while dry soil favors sudden, violent discharges. Therefore during periods of increasing underground water danger of accidents caused by lightning decreases.

— In *The American Magazine* for October, Dr. William F. Hutchinson furnishes another of his charming South American papers, describing in this issue the Orinoco River; Helen Strong Thompson contributes an illustrated paper on the 'Sacred Quarry in the Great Red Pipestone Country;' and Florence A. Davidson has an illustrated paper on 'Pioneer District Schools.' In addition to the literary features, are a series of papers on practical questions of the day: a few of the many legitimate ways in which 'the surplus' can be utilized are shown by M. W. Hazen; Mr. Hazen makes a plea for a national training-school; Mr. M. M. Estee has a paper showing the effect of free trade on Pacific coast industries; Mrs. J. Ellen Foster, chairman of the Women's National Republican Committee, argues that "prohibition is not a national issue;" and Mr. Enoch Ensley of Tennessee gives 'A Southerner's National View of Protection.'——Roberts Brothers have just ready in their Famous Women Series 'Elizabeth Barrett Browning,' by John H. Ingram, which is the first biography published of this author. ——Professor Bryce's book on the United States, which he hopes to have ready in November, the London correspondent of the New York *Times* thinks, "will probably rank high among the most im-

portant studies of the American Republic by foreign hands. It examines very carefully our whole governmental structure, Federal and State, and the social economy and political foundations on which the edifice rests."——*The Kindergarten*, Chicago, is fulfilling its claims to give to mothers of young children methods of amusement combined with instruction. 'Nursery Occupations' and 'Typical Lessons,' in the October issue, give practical hints that alone would pay the price of subscription.——*The English Illustrated Magazine*, published by Macmillan & Co., is to be enlarged to seventy pages, the price remaining the same (15 cents).——Edward Meeks, Philadelphia, has in preparation a second edition of Roper's 'Handbook of Modern Steam Fire-Engines.'——'Gardner's School Buildings' (E. L. Kellogg & Co., 25 Clinton Place, New York) will be out this week; also (by same publishers) No. 11 of Teacher's Manual Series, entitled 'The Argument for Manual Training,' by Dr. Nicholas Murray Butler.——In the *Overland Monthly* for October is a paper on fog and fog-signals on the coast, by Mr. F. L. Clarke, who developed some facts of importance to seafarers on 'areas of inaudibility' of signals.——The *New York World* has in preparation 'The World Almanac for 1889.'

LETTERS TO THE EDITOR.

Kiessling's Twilight Phenomena.[1]

SIMULTANEOUSLY with the publication of the 'Royal Society's Report upon the Krakatoa Disaster and its Results,' comes the most important German contribution to that section of the subject treating of the abnormal glows, — a subject which occupies two-thirds of the 'Royal Society Report,' of nearly five hundred pages. The bulk of the contained matter is nearly equal in the two books; but it is drawn from such diverse sources, and the views propounded in the theoretical parts are so different, that only a small proportion of the whole appears in duplicate. The beautiful colored plates in each curiously support the main theory of the book, their fidelity to nature indicating the probability that the diffractive effects advocated by Professor Kiessling and the reflection upheld by the 'Royal Society Report,' each have a share in the final result.

The historical introduction deals with the study of twilight phenomena: Von Bezold's admirable summary (the work is dedicated to the distinguished director of the Berlin Royal Meteorological Institute) is given in detail. The work is then divided into two parts, four sections treating mainly of observations, and two of experiment and conclusions.

Section I. gives a detailed list of glows in forty-four years, noting any coincidences with earthquakes and eruptions. The three opening dates are 989, 1117, and 1554. There are at least seven earthquake coincidences, the associated glows being strictly local. The 'Royal Society Report's' list is of the one hundred and fifty-five chief volcanic eruptions since 1500, and glows (thirty-one in all), in parallel columns. Thirty of the latter coincide with eruption years, which number is increased nearly one-half by Kiessling's tables. Most worthy of notice is the remarkable completeness of detail concerning the European glows after the eruption of Graham's Island, near Sicily, which was also submarine.

Section II. largely occupies the ground of the 'Royal Society Report,' Part IV. Sect. II., both being lists of special appearances since Aug. 26, 1888, approaching nine hundred each in number. The former, however, continue on to the close in 1886, while the latter are chiefly confined to 1883. The immense amount of valuable records obtained from the ships' logs of the two countries is very striking. It will be a great pity if similar work is not performed in connection with the merchant marine of North America. The North American land-returns have been copiously drawn upon, especially by Professor Kiessling, thanks to the *Monthly Weather Review*; but here, again, there must be a rich store of private records awaiting collation.

Four excellent maps, for Aug. 26 to Sept. 30, for October, November, and December, 1883, contain localities, with dates, for the glows, by which their progress can be easily traced. With the same object in view, the records in the list, up to the close of November, are arranged in four parallel columns, according to longitude.

Professor Kiessling throughout treats the bright 'glory' round the sun, known as 'Bishop's ring,' as the most important phase of the glows. Section III. describes its appearance, spread, and changes, the explanation forming an important portion of the second part. His already published and generally accepted explanation of it by diffraction is there supported by a most interesting series of experiments. The equally unique appearance of the counter-bow, at the point opposite the sun directly after sunset, he thinks is to be regarded as of similar origin. This was noted in Europe almost simultaneously with the glows: on Nov. 27, 1883, and Dec. 15 and 20, at Sunderland, by Mr. T. W. Backhouse; Dec. 22, 1883 (not 1884 as misprinted in 'Warner's Prize Essays,' p. 40), by L. Richardson at Newcastle; on Dec. 29 to Jan. 3, by Herr Jesse, Steglitz; and on Jan. 12, 1884, by the writer. Measurements by the first and last prove identical with those of Bishop's ring. As most people chiefly regard the rising or setting sun, the anti-solar phases escape observation. Hence all observations of the counter-bow would specially repay collation.

In Section IV. Professor Kiessling, dealing with the outspread of the glows, shows that the originating cloud-haze must have consisted at first of distinct streams, the probable courses of some of which he indicates. The velocities of outflow he fixes at between sixty-seven and eighty-nine miles per hour, as against seventy to eighty-four, the extreme values deduced in the 'Royal Society Report.' Both conclude that the height, for Europe, was about twelve miles.

The artificial formation by diffraction in dust, condensed vapors, etc., forms the subject of Section V., which opens the second part, and his simple but effective experiments deserve wide repetition and development. Incidentally capital illustrations are given of cloud-formation. His previous publications upon this subject are considerably expanded, and fresh applications made. As already stated, they form the main basis of his contention for diffraction as the paramount cause of all the phases of the glows, admitting, however, reflection as a subsidiary agent. His method of treating the glow-colors concentric to the sun apart from the glow-colors parallel to the horizon, upon which, during the twilight, the former are superposed, greatly simplifies their elucidation. Probably his arguments as regards the former class will be regarded as the more convincing, especially as diffraction so obviously explains Bishop's ring. As to the horizontal layers, no doubt diffraction plays a considerable part, but as certainly Messrs. Russell and Archibald, in the 'Royal Society Report,' rightly uphold reflection as the main factor. In this they are supported by Professor Ricco. Of the various objections brought forward by the latter, two may be noted. Professor Kiessling accepts the interposition of clouds or mountain-peaks as the cause of the dark bars often dividing the first glow; but this could hardly apply if the main light is due to diffraction. Again: with the others he considers the second glow to be a reflection by the haze-layer of the first. Such a surface, then, would surely reflect direct sunlight as well.

To some of the objections, however, the present work indicates Professor Kiessling's probable reply; as, the possibility of the dust-haze so quickly assuming the homogeneity required by his theory, and the occasional appearance of day and twilight glows independently. We may also notice that he ascribes the haze-cloud chiefly to condensation products, while the 'Royal Society Report' favors mirror-like surfaces from microscopic pumiceous bubbles, — conditions in each case in harmony with the adopted theory. The discussion of tropical sunsets at Loango and in South America provides Professor Kiessling with several strong points, for in these instances he is able to show a remarkable agreement between observation and experiment. The excellent colored sketches by Dr. Pechnel-Loesche are here a material assistance.

The general arrangement of this valuable work is well adapted for reference. Only one misprint of any moment has been noted: on p. 55, § 44, "110°O" should apparently be "120°O," or the "Middle Dog" Lighthouse lies some distance inland in China. The printing is most exquisitely clear, which is no small boon, for the title is not the only word, which, to eyes accustomed chiefly to English words, are almost appallingly long.

J. EDMUND CLARK.

[1] Untersuchungen über Dämmerungserscheinungen, zur Erklärung der nach dem Krakatau-ausbruch beobachteten atmosphärischoptischen Störung, von J. Kiessling. Hamburg and Leipzig, Leopold Voss, 1888.

Sorting Colored Wools when Blindfolded.

YOUR reviewer considers that the experiments of Professor Fontan, in which an hypnotic subject sorted colored wools with his fingers when his eyes were completely covered, are simply incredible. It is true that they are so hard to believe in, that a single instance can produce scarcely any effect at all; but they cannot be considered as absolutely incredible, in view of the fact that Prof. Vitus Graber has shown that so thick-skinned an animal as the cockroach re-acts to colors when his antennæ have been removed and his head has been covered with a thick coating of black sealing-wax. M.

Classification of Soils.

IN the highly interesting summary of the forthcoming report of Director Powell, given in the issue of *Science* of Sept. 28, it is stated that in this report is announced a "new, scientific, and systematic classification of soils," a summary of which is then given.

Your correspondent is evidently unfamiliar with the standard and current literature of the subject. Director Powell simply adopts, for the purposes of geological field-work, a "working classification of soils," based upon their geological genesis. It is scientific and systematic, but certainly not new to any of those who have been concerned in such work, or have mapped its results from the standpoint of the geologist. Major Powell substitutes, perhaps wisely, the terms 'endogenous' and 'exogenous' for the more familiar ones of 'sedentary' and 'transported;' and instead of classing lacustrine and marine soils under 'alluvial' as a general head, he restricts the term 'alluvial' to those soils formed by *running* water only. I doubt the advisability of the latter change, unless we cease also to speak of lacustrine and marine alluvium, using some other term for the general idea of genesis by recent alluvion.

Major Powell also apparently proposes to replace the old term 'colluvial' by that of 'overplacement' soils. I doubt that even from the geological standpoint this is an improvement, for within this class must be placed the larger portion of the arable soils of hill-lands (there being no other within which they can regularly fall); and these certainly result more properly from 'colluvion'—i.e., a 'washing-together' and intermixture of the various materials on the slopes—than from what may properly be termed 'overplacement.'

As a schedule stated by himself to be merely tentative and for the purposes of field-work, and published only in an abstract made by a third party, Major Powell's classification is not yet a proper subject for extended comment. But it cannot but be a matter of congratulation that the subject of soils is now to receive close attention in the field-work of the survey, and will doubtless thereafter be subjected to such further elaboration as may be necessary to render the results available for agricultural practice.

E. W. HILGARD.

Berkeley, Cal., Oct. 5.

Recent Information from the Muir Glacier, Alaska.

IN my paper upon the Muir glacier, published in the *American Journal of Science* for January, 1887, I gave on pp. 11–12 a summary of the reasons for believing that the front of the glacier was retreating at a pretty rapid rate. Recent information confirms this view in a striking manner. I learn through Captain Hunter that upon June 27 last he established an observation station upon the glacier, and took accurate notes and measurements both then and in his recent trip in September, and found that during the three months of absence the glacier had broken off, and receded inland one-fourth of a mile. Whether this distance is regained by the forward motion in the winter or not, remains to be seen. Doubtless the captain can determine this when he returns next summer. According to my own observations during my prolonged visit in 1886, the central point of the glacier, where it meets the water of the inlet, remained nearly stationary, although great masses were repeatedly seen to break off from it, and sometimes it seemed during an interval of a few days to have receded perceptibly, while at other intervals it had regained its position. But from Captain Hunter's observations this season, it would seem that the waste consequent upon the formation of icebergs is greater than is supplied even by the rapid motion of the glacier (from sixty-five to seventy-two feet per day), demonstrated by my observations to have existed a mile or two back from the front. Captain Hunter also reports that immediately in front of the ice his sounding-line ran out one hundred and six fathoms without reaching bottom; and, since the ice rises about four hundred feet above the water, there must here be a depth of more than a thousand feet of ice.

G. FREDERICK WRIGHT.

Oberlin, O., Oct. 11.

Chalchiuitl: A Note on the Jadeite Discussion.

IN his very valuable and interesting note on jadeite in *Science* of Oct. 5, Dr. Brinton called attention to the fact that Bernardino Sahagun had mentioned *iztac chalchiuitl* as being white chalchiuitl, fine green, and quite transparent, and also says that the white chalchiuitl was obtained from quarries in the vicinity of Tecalco, which he (Dr. Brinton) believes to be the modern Tecali. If such is the case, it is very evident that this is the so-called Mexican onyx, 'Tecali marble or onyx,' as it is sometimes called, which exists there in veins, being in reality an aragonite stalagmite. Great quantities of it were made into Mexican figures, ornaments, and beads, which are found all the way from northern Mexico down to Oaxaca. This so-called onyx is extensively quarried to this day, forming one of our richest ornamental stones.

The definition of *quetzal chalchiuitl*—"precious chalchiuitl, white, with much transparency, and with a slight greenish tinge, something like a jasper"—is somewhat contradictory, if it was intended for jadeite. A variety of green stones exist at present, and were used in considerable abundance in ancient Mexico. Among eight green stone objects which have been recently sent me as jadeite, four are jadeite, one is a laminated serpentine, another is a greenish quartz, and the other two are a mixture of white felspar and green hornblende.

In a string of beads there are four pieces of jadeite; but all the others were, as are the jadeite beads, in the form of rounded pebbles, drilled from both sides, and there are nearly a dozen different substances in this string. The fact that these jadeite beads were strung in with the others, apparently without any order except that they were graded to taper toward each end, points very strongly to the conclusion that they were found with the other pebbles in a brook, and, being of the correct size, had been drilled the same as the others, although very much greater in hardness. The question is, are these pebbles a part of the tribute mentioned in the Codex Mendoza referred to by Dr. Brinton? If so, they must have existed in some abundance; and they have not been reworked from other objects, as are the larger pieces, like the Costa Rican celts. Can it be that the large ones came from lower Mexico, and, after being used as implements, were traded off, but being green stones, which have been given the preference the world over by savages and barbarians, were made into votive objects? Among other green stones used by the ancient Mexicans are green jasper, green plasma, serpentine, as well as a fine-grained green shale and this Tecali marble, often of such a rich green that at a glance it could be mistaken for jadeite.

Dr. Brinton's theory that Vilalta (Zoochila), in the State of Oaxaca, is the possible home of large pieces of jadeite, if it exists in Mexico, is a good one, since some of the largest jadeite ornaments known, including the great sixteen-pound votive adze, were believed to have come from that district, and it was from a quantity of pebbles from one of the streams of this region that the writer identified yellow and blue sapphire almost as pure as the Ceylonese, being one of the only materials with which jadeite can be worked.

Dr. Meyer is quite right when he calls the *Nephritfrage* at present a chemical problem; for the mineralogist, by analysis and with the microscope, can readily distinguish the many substances of one kind or another that are sold as and called jade even by the Chinese, among which are jadeite (*feitsui*, or imperial jade), jade or nephrite, green avanturine, green plasma, light-green jasper, green hornblende, serpentine, agalmatolite artificially stained green, and in one instance even green-and-white glass, which last material was presented as jade by a Chinese official to an American lady.

GEORGE F. KUNZ.

New York, Oct. 15.

Dry-Goods by Mail.

Among the dry-goods announcements in this week's issue of *Science* will be found one of Messrs. James McCreery & Co., inviting the attention of the readers of *Science* to a line of fine Black Goods at bargain prices. This firm have a special department for mail order business, and give particular and most careful attention to all communications from customers residing at a distance.

Insurance.

DELAY IS DANGEROUS.

We call attention to the new form of Accident (indemnity) Insurance policies, which are written by the Merchant's Casualty Insurance Association, 21 Park Row, New York City. John S. Purdy, Secretary. These policies cover weekly allowances of from $10 to $25, according to occupation, at a cost of only $6 a year exclusive of the cost to join, which is $5 payable once only. The public, as a rule, carry life insurance, and the ordinary accident policies issued by companies, paying a sum in case of death, is not so desirable as one of these indemnity policies in case of accidents, which are so plentiful in this fast age with its railroad horrors, fast driving, electric wires and other countless forms of danger to which the public is constantly exposed. The fact of the Association having no unpaid claims, and its having just passed an examination by the Insurance Department of New York State, shows that the management is liberal with its policy-holders and conservative in its action. The Association also desires to secure energetic Agents in every village and town, to whom territory and favorable terms will be given.

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SCIENCE

FRIDAY, OCTOBER 26, 1888.

THE POLITICAL EVENTS in East Africa and the death of Major Barttelot have made the position of Emin Pacha, and probably that of Stanley, very difficult. Since the English have given up the Sudan to the Mahdi, the Europeans have lost much of their influence over the Arabs, who feel that they are able to resist European influence. As at the present time English and German traders are making rapid progress in Central Africa, and as the Sultan of Zanzibar has yielded his political power to Europeans, the Arabs are in fear of losing their profitable trade and of being compelled to abandon their slave-raids. This fear, combined with the consciousness of their power, makes the situation in eastern Africa one of great difficulty. It is erroneous to ascribe the disturbances to oppressive or offensive acts of European, especially of German officials, as the sole fact of their presence and of their progress is a satisfactory explanation. As a matter of fact, the disturbances have not originated in, and are not confined to, German territory. In April severe struggles took place between the Arabs and English traders near the northern part of Lake Nyassa. Since the German East African Company has taken possession of the coast of the mainland, the hatred of Europeans has received a sudden stimulus, and the Arabs, aided by their native supporters, everywhere offer resistance to European travellers. Thus Dr. Hans Meyer's second expedition to the Kilima Ndjaro has been scattered, and all further expeditions starting from Zanzibar have been made impossible. Besides this, new complications have arisen in the lake region. The last news from Uganda was dated June 27. According to it, communication with Emin is again absolutely interrupted. While for a long time Kabrega, King of Unyoro, seemed to be friendly to the whites, he has all of a sudden turned against them; and it would seem that the cause of his change of mind may have been either the fear of Stanley's arrival and the subsequent strengthening of Emin's power, or the advice of Arabian traders. However this may be, he has killed Mohammed Biri, the Tripolitan trader, who, in 1886, opened a trade between Uganda and Wadelai at the instance of Dr. Junker, and was the only one to continue it, and thus keep us informed of what was going on in the Equatorial Province. It would seem that Kabrega has also caused the unfortunate Captain Casati to be murdered, but it may be that this news is not correct. On account of this new interruption, the last news of Emin dates back to Nov. 2, 1887, and it seems not improbable that Stanley may meanwhile have reached him. It must be borne in mind that the news of Stanley's death and of the destruction of his caravan would have reached us from some direction. H. Wichmann, in the October number of *Petermann's Mitteilungen*, reminds us, rightly, that the news of the destruction of Hicks-Pacha in Kordofan on Nov. 5, 1883, was known in Lado in March, 1884; that the capture of Lupton Bey in the Bar-el-Gazal Province was known in November in Khartum. Events of such importance as the destruction of a whole caravan headed by many whites would have been reported and known all over the country within a few months. Undoubtedly both men, Emin as well as Stanley, are in a position of great difficulty. We are unable to know whether they have succeeded in uniting their forces since Nov. 2, 1887. The danger of their situation arises not so much from attacks of petty tribes, as from the general feeling of power and distrust against Europeans among the Arabs, and eventually in Uganda and Unyoro, and from the impossibility of obtaining the necessary ammunition and provisions. If the story of the 'White Pacha' had referred to any important event, it is probable that we should have had additional information from the Bar-el Gazal region.

THE INTERNATIONAL GEOLOGICAL CONGRESS.

THE fourth session of the International Geological Congress was held in London from Sept. 17 to Sept. 22. *Nature* gives a full report of its proceedings, from which we take the following notes: —

So far as members go, the congress was a complete success, as it was more largely attended than any previous meeting, both by home and by foreign geologists. The success of such a gathering may, however, be reckoned on other lines, and here opinions on the subject may differ. Those who hold that the first duty of such a congress is to formulate rules and to fix nomenclature may well feel some disappointment; for although excellent discussions took place, and the general feeling was often evident, no formal vote on any such subject was taken. It was generally felt that votes from such mixed assemblages have no value.

Three invitations for the fifth meeting of the congress in 1891 were received from America, — from Philadelphia, New York, and Washington. Philadelphia was chosen. A committee of American geologists was appointed to take such steps as it thought necessary to make the arrangements for this meeting. The committee consists of Messrs. J. Hall, Dana, Newberry, Frazer, Gilbert, Hunt, Marsh, and Walcott.

When the congress met at Bologna, much of the time was occupied with discussions upon the exact meanings to be attached to various geological terms, and upon the general principles which should guide us in geological classification. Certain rules were then laid down, which probably few authors have consistently followed, and which it is unlikely will be universally adopted. At Berlin the discussions turned more upon precise questions of classification, especially those relating to the sedimentary rocks; upon the lines by which various groups of strata should be marked off; and, in some cases, upon the names by which these groups should be known. This change of procedure was necessitated by the progress made with the international geological map of Europe; the material for such discussion on classification having been provided in the shape of reports from various national committees, of which that from England, presented by Professor Hughes, was by far the most complete.

At the London meeting the classification of the Cambrian and Silurian strata was fully discussed; and two other questions, only lightly touched upon before, were here considered in some detail, — the nature and origin of the crystalline schists, and the upper limit of the tertiary system.

In Bologna numerous votes were taken, in Berlin several, but in London none. It was recommended that members of the country in which the congress meets should vote separately from the foreign geologists: if the votes of the two groups agree, the question will be taken as settled; if they disagree, the further consideration of the question will be postponed. The resolution further recommended that votes should not be taken on questions which are purely theoretical (such questions to be simply discussed, and various views obtained), and that decisions of the congress should only refer to the more practical questions.

Two commissions of the congress have existed since the Bologna meeting, — that on the map of Europe, and that on nomenclature and classification. The work of the former is plainly marked out, and much has yet to be done. The other commission has, however, in many respects served its purpose: it has obtained reports from the various national committees, most of which have been ably summarized by Professor Dewalque. The future work of the congress will partly lie in discussing these reports, and in deciding such questions in general classification as may apply to wide dis-

tricts, leaving minor points to be worked out by each country for itself. A commission was therefore appointed with altered and somewhat wider powers. Its functions will more fully shape themselves at the congress in Philadelphia.

The report upon the map of Europe was presented to the congress by Dr. W. Hauchecorne. This stated the progress which is being made. Four or five sheets of Central Europe will be ready for publication during the next two years; and it has been decided to publish the sheets as completed, each with its own title and index, instead of waiting for the completion of the whole of Europe, as was at first intended.

Very little time was given to the map in the public sessions of the congress; but the map commission had three long sittings, the results of which will be printed in the official report. The most important points arrived at were the adoption of the term 'pleistocene' for the index of the map (the German term '*quartär*' to be bracketed with this); the separation of the modern deposits from the pleistocene, and the mapping of the latter wherever practicable, the underlying formations (where known) to be distinguished by colored lines; in modern eruptive rocks (those of volcanoes now active or only recently extinct) the stratified volcanic tuffs are to be distinguished from the cinders and the scoriæ.

M. Karpinski has been the representative of Russia on the map commission. On this occasion he was not present, his place being taken by MM. Nikitin and Tschernicheff. The latter submitted an important note on the crystalline schists of the Ural Mountains, which would have enlivened the discussion upon this question in the public meetings of the congress. He states that the crystalline schists of the Urals contain limestones with a distinct Hercynian fauna, and also that the schists pass horizontally into Devonian strata. It is probable that in cases of this kind (and similar cases elsewhere were referred to in the public discussion) the schists will be represented by the color denoting their presumed age, while their present lithological character will be denoted by colored lines. M. Nikitin raised a point which is important in many parts of Europe, but which is especially so in Russia; that is, the necessity of distinguishing transition-beds. He instanced the Volgian beds, which link the Jurassic with the cretaceous; the Tartarian, between the Permian and the trias; and others, spoken of by M. Nikitin as Permo-carboniferous, which link the Permian to the carboniferous. These transition-beds occupy immense areas in Russia, and cannot well be fitted into the existing classification.

The discussion on the crystalline schists occupied the whole of the sitting on Wednesday, and part of that on Friday. The material for this discussion had been provided by a collection of papers printed in advance and distributed at the opening. A number of these papers were contributed by five officers of the United States Geological Survey, with an introduction by Major Powell; and by Mr. Lawson, of the Geological Survey of Canada.

In the foregoing notes we have not attempted to summarize the discussions. We have preferred to devote the space at our disposal to a general survey of the meeting, and to note some points of importance which could not well be included in a formal report of daily proceedings. The discussions may by some be held to have led to no definite result, inasmuch as no vote was taken, and therefore no formal decision of the congress can in future be appealed to. But the great value of such meetings lies in the opportunity afforded for personal discussion, and the interchange of opinions, not only in the public sessions, but in the more easy and informal conversations over the exhibits in the museum, in the corridors and reading-room, and at the friendly and social gatherings which made so pleasant a feature of the London meeting. We have no doubt that the general result of this meeting on geological opinion and progress will be at least as good as that of any which has gone before.

THE DEVELOPMENT OF THE CULTURE OF NORTH-WEST AMERICA.

IT is well known that the Indian tribes of the north-west coast of America far excel their neighbors in their arts and industries. This phenomenon is of great interest, and well-deserving a thorough study. What was the origin of this culture? Which among the numerous tribes of this region proved of an intellect so superior to that of all their neighbors? Is it possible to trace the unwritten history of this culture? All these questions are of interest to the historian, as well as to the ethnologist who tries to solve the psychologic laws of human development.

The north-west coast of America is inhabited by tribes belonging to a great number of linguistic stocks, — the Tlingit and Haida, the Tsimshian, the Kwakiutl, the Nutka, and the Salish. The physique of the northern tribes reminds us of the Japanese. The Kwakiutl are characterized by a comparatively long skull; the Salish, by an exceedingly short one. Our knowledge of the physique of these tribes is too imperfect to trace their genealogy. We may, however, trace their history by studying their customs and languages. It seems that the languages enumerated above represent as many different linguistic stocks, so far as our limited knowledge tends to show. Regarding the logical basis of grammar, we may distinguish three groups: the first comprising the Salish, Kwakiutl, and Nutka; the second, the Tsimshian; the third, the Tlingit and Haida. The formation of words and the grammatical inflection in the first group are effected by means of affixes and reduplication. The languages distinguish between sexes and between present and absent objects. What we call the adverb is the inflected part in their sentences. The second group is characterized by its entirely verbal character, nouns and verbs — if we may use these terms — being treated in the same way. There is no grammatic gender; but the past, present, and future tenses, as well as presence and absence, are distinguished. The plural has the same peculiarity as that found by Major Powell in several Shoshone dialects, different stems being used for singular and plural. The third group, the Tlingit and Haida, is characterized by the lack of inflected forms, juxtaposition of stems being the principle of grammatic structure and of the formation of words. These languages might almost be considered as belonging to the class of isolating languages.

These are the principal facts which we have to bear in mind in studying the culture of these tribes.

The best basis for ethnological comparisons are collections of specimens and collections of myths. The latter are the best clew to the religious ideas of a people, and reveal many remarkable customs which would escape the notice of the casual observer. A full account of the customs of these tribes is not yet available, as no scientific traveller has devoted sufficient time to their study.

The legends of these tribes are of a comparatively uniform character all over the north-west coast of America. This fact is not surprising, as the customs of all the tribes are very much alike. A careful analysis, however, shows important points of difference. It is true that the same elements occur over and over again, in varying combinations; but this phenomenon will not mislead the student, as it is one of the characteristics of myths, that in course of time they are developed by the addition of well-known elements. When we try to separate these elements from the legends, a series of myths remain which we are unable to trace to a common source.

As regards the elements common to all these traditions, their gradual distribution may be traced in studying, for instance, the legend of the 'Visit to Heaven,' which is known all over North-West America. The legend is one of the most important in the mythology of all Salish tribes, the tale being that men and animals made a chain of arrows reaching from heaven to earth, climbed it, and killed the sun. We find this same idea of the ascent to heaven incidentally used among the Tsimshian, only for the purpose of embellishing one of their legends. On the other hand, the tales of the adventures of the raven, which form the basis of the Tlingit mythology, are known on Puget Sound, where they form incidents in certain other myths.

Historical legends prove the correctness of our view that well-known elements of traditions are added to tales, and that their development is exclusively in this line. The Sitka Indians, for instance, have numerous legends referring to the administration of Baranoff. All of them have the same style that may be observed in their myths. Therefore, in studying the mythologies of these tribes, we must assume that each was in the possession of a certain stock of legends, which they carried to the coast. Whether these

originated among the respective tribes, or whether they were influenced by their former neighbors, it is impossible to decide. In course of time a common civilization of the coast tribes developed, and at the same time the exchange of legends began. Certain elements which had reference to their common mode of living must have spread most rapidly. Thus the basis of many legends is the late arrival of the salmon and other fish, and consequent starvation, or accidents to hunters and sealers. Just as frequently mention is made of persons who were believed to be possessed by evil spirits, and who were left alone to starve. Most of these elements are so widespread and of so frequent occurrence, that no theory as to their origin is possible.

Setting aside this point, the legends may be arranged in a number of groups which approximately correspond to the linguistic divisions.

The legends of the Tlingit are principally known through the researches of Vemiaminoff and Krause; those of the Haida, through Dawson. They may be considered as identical, as the existing discrepancies are not greater than variants obtained from several individuals of the same tribe. In both peoples the raven legend is the basis of their systems of mythology, and in both of them the interesting struggle between the Raven and his uncle occurs.

The legends of the Tsimshian contain several elements foreign to the first group. The study of their myths leaves the impression that they originally worshipped the heaven, and that stars, trees, and animals were the mediators between heaven and men. Sun and moon were deities or mediators of great power. Mixed with this idea we find the raven legend, and everywhere we notice the endeavors to give each, the raven and the heaven, its proper importance in the system of myths. Thus it happens that the Raven is made the grandson of Heaven. Many characteristics of the myths referring to heaven have the appearance of having been adapted only with difficulty to the myths of the neighboring tribes, and remind us of people living far to the south-east in the interior.

The myths of the Kwakiutl are very remarkable. They are one people, speaking one language with hardly any dialectic differences; and still the legends of the northern tribes are entirely different from those of the southern tribes, while those of the central ones are still of another character. The only legends that are common to all of them refer to the great religious winter dance. It is doubtful whether the legend of the Great Wanderer, who transformed men into animals, is known to all of them, or whether it is unknown to the most northern tribe, the Qaisla.

Last of all we have to consider the Salish. The great heroes of their myths are the Great Wanderer, whom I mentioned just now, and the sun, many stories referring to whom are told.

In an attempt to inquire into the origin of these legends, we must study the etymologies of mythological names. It is true that the greater number are derived from roots belonging to the language of the tribe who tells the legend. A considerable number, however, are borrowed words, and thus the origin of the legend is indicated. This is, for instance, the case in regard to the mythical figures which occur in the dances of the Kwakiutl. I found the Kwakiutl names used by the Nutka, Salish, Tsimshian, and Haida. This fact seems to indicate that these legends and customs have spread at a comparatively recent date over the coast, and it is a proof that they originated among the Kwakiutl. Another instance of this kind may be observed among the Bilqula. The ancestors of some of their clans have Kwakiutl names. Their word for shaman (*atloqoala*) is a modified form of the Kwakiutl word *tlokoala*. These facts prove a long and intimate intercourse between both tribes.

It is very difficult to arrive at an understanding of the original myths of the Kwakiutl, as the northern tribes have only very few of the customs and traditions peculiar to the southern tribes. Even their social organization is not the same, matriarchate being peculiar to the northern group, patriarchate to the southern. On account of philological considerations, I think that the social organization of the Kwakiutl was originally patriarchal, or it may be more correct to say that the male and female line had equal rights. This opinion is founded on the fact that even among the tribes among whom matriarchate prevails at present, the same terms are used for denoting relationship in the male and female lines. We have therefore to inquire how it happened that the northern tribes of this people adopted the matriarchate. Undoubtedly this is due to the influence of some of their neighbors.

A study of the mythologies of the coast shows that among the northern tribes, who have a matriarchal organization, the raven legend occurs in the same form in which we find it among the Tsimshian. It shows the same connection with the sun-myths which it has among the latter. Besides this, the division into gentes of these tribes is similar to that of the Tsimshian, who have four gentes and no phratries, while the Kwakiutl have three gentes and no phratries. The Haida and Tlingit, on the other hand, have numerous gentes, which are arranged in two phratries, — the raven and the eagle. The crests of the Tsimshian are the eagle, raven, wolf, and bear; those of the Kwakiutl, the raven, eagle, and bear. For these reasons it seems that the Tsimshian have modified the customs of the northern Kwakiutl.

There is one important consideration which leads us to the conclusion that the Kwakiutl were never immediately influenced by the Haida. It is the fact that none of their customs are found among the latter, except when carried there by the Tsimshian. Only a few Tsimshian tribes practise all the dances of the Kwakiutl, and it was only in the beginning of this century that the Haida began to borrow them from the Tsimshian. It might seem that the Tsimshian themselves imitated these dances only recently, as they have not spread over the whole people; but it must be borne in mind that the right of performing the dances is acquired only by means of marriage, and that it is watched with great jealousy. It is well known that such prerogatives are frequently preserved for long periods. Nevertheless it appears remarkable that these dances have not spread any further through intermarriage, if the reverse influence of the Tsimshian upon the Kwakiutl was sufficient to modify their social organization entirely.

I am inclined to believe that another custom of the North-West Americans besides their dances originated among the Kwakiutl. I mean the use of heraldic columns. This view may seem unjustified, considering the fact that such columns are made nowhere with greater care than in the northern regions, among the Tsimshian and Haida, and that farther north and south they are less frequent and less elaborately carved. The Haida, however, frequently took up foreign ideas with great energy, and developed them independently. We mentioned above the winter dances, which undoubtedly originated among the Kwakiutl. The use of red cedar-bark is connected with these dances. A glance at the existing collections shows that the Haida have more elaborate and varied forms of rings than any other tribe. This variety leads us to the conclusion that their dances are of similar diversity. It appears that this tribe has a remarkable faculty of adaptation.

This fact is important in considering the history of the use of heraldic columns. The division into gentes has a far greater importance in the life of the Haida than in that of any other tribe of the coast, although the mythologic foundation and the division itself are the same. The gentes and phratries of the Haida and Tlingit are identical; but while the former use hardly any heraldic columns, and do not tattoo themselves to any great extent, the columns of the Haida surpass those of the Tsimshian in size and beauty of workmanship. The faint traces of tattooing found among the Tsimshian are developed among them into an elaborate art; breast, arms, legs, feet, and back being tattooed.

A study of the legends of all these tribes shows that only the traditions of the Kwakiutl frequently allude to heraldic columns. It is true that such tales may originate in the desire to give greater importance to the possessor of such a column; and this is the more probable, as the Kwakiutl are very vain; but I think the columns are mentioned too frequently, and they are too intimately connected with important myths, to allow us to hold this idea.

I turn to considering the Coast Salish tribes. It is well known that tribes of this linguistic stock inhabit the greater part of southern British Columbia and Washington Territory: therefore the tribes of the interior must be considered in our inquiry. The mode of life of the inland divisions of this people is entirely different from that of the coast tribes. The latter live in large houses, which are similar to those of the northern coast tribes except that they are longer. They are fishermen, and use the canoe as extensively as

the Kwakiutl. The tribes of the interior, on the other hand, live in underground houses, and are hunters as well as fishermen. The hero of the Salish myths seems to be the Sun, and legends are found referring to the murder of the old sun and the origin of a new one. I am not equally sure that the legend of the Great Transformer originated among the Salish. On the coast he is undoubtedly considered the deity, but he is of far less importance among the Ntlakapamuq of Thompson River. I do not know whether the legend is known to the Salish of the interior of Washington Territory, but we know that it is known to the Chinook of Columbia River. It is also the foundation of the Nutka mythology.

Patriarchate prevails among the Salish. The division into gentes, however, is not very clear. There exist prerogatives of certain groups of families, particularly regarding the winter dances and the use of masks. The latter is undoubtedly derived from the north, as masks are few, and as it seems that they are not used by the inland tribes.

The study of the use of masks calls our attention to another interesting fact. The masks of the most northern one of these peoples, the Tlingit, have certain remarkable ornaments, representing figures of animals, which are attached to the faces. Beside this, they are not as conventional as those of the southern tribes. The masks of the Eskimo of southern Alaska have the same peculiarities, and this leads us to conclude that a mutual influence existed here. A careful study of the religious ideas of these tribes reveals another fact that strengthens the foregoing conclusion. The Tlingit as well as the Eskimo believe that there are two regions to which the souls go after death: those dying a violent death go to heaven; those dying of sickness go to a lower world, which the Eskimo believe to be under ground, while the Tlingit say that it is outside the world, on the same level with the earth's surface.

I have attempted in the preceding remarks to elucidate a few points regarding the history of North-West American culture. I have shown that it is not uniform, and that it is derived from various sources. Those facts seem to be the most convincing which prove that various tribes belonging to the same linguistic stock have not the same social organization and customs. Unfortunately the available material is not sufficient to complete our inquiry. A knowledge of the tribes of Gardner Channel and of the Salish of the interior, as well as of their southern neighbors, is indispensable in tracing the origin of the legend of the Great Wanderer.

One of the results of our inquiry is the discovery of the deep influence wrought by the Kwakiutl upon the development of their neighbors. It may be that this influence is still more important than it seems at present. The foundation of the mythology of the Kwakiutl tribes is obscure, as they themselves are much influenced by another great group of tribes, — the Tlingit and Haida.

These two tribes will form one of the most interesting objects of further researches. Their languages are very much alike in structure, while their vocabularies show great differences. Their customs and traditions are alike; but the Haida are influenced by their southern neighbors, through their frequent intercourse with the Tsimshian. The fact that the arts of the Tlingit and Haida are not of the same character is important, as it seems to prove that the arts are of foreign origin, but attained their highest stage of development here.

The legends of the Tsimshian favor the theory that they reached the coast much later than the other tribes. The Nutka, finally, are so much influenced by the Kwakiutl, that a study of their customs does not reveal any facts as to their origin. F. BOAS.

THE increase of population of France is steadily growing less. In the past year the number of births was 899,333; of deaths, 842,-797; or 23.5 and 22 per thousand respectively. The excess of births over deaths has decreased since 1881 from 108,229 to 56,536, or 48 per cent. The *Revue Scientifique*, from which we take these figures, comments in a very interesting editorial on the connection of these facts with the question of retrenching immigration into France, which is at present favored by the government and by the people, and shows that the only remedy is to open France to an unrestricted immigration from neighboring countries.

SCIENTIFIC NEWS IN WASHINGTON.

Photographs made on Surfaces Feebly Sensitive to Light: Making Pictures on Printing-Paper and Wood without Previous Preparation of the Surface. — A Town in Florida where they deserve to have Yellow-Fever: Dr. Posey's Report on the Sanitary Condition of Macclenny. — Do we carry an Electric Battery within us? — Floating Wrecks a Source of Great Danger to Ocean Navigation: The International Marine Conference to discuss the Subject. — The "King Devil." — How to see Insects and Plant-Roots under Ground.

Surfaces Feebly Sensitive to Light.

SOME interesting experiments have recently been made by Mr. J. W. Osborn of Washington, on the sensitiveness of different surfaces to light, the results of which he has described in a paper, of which the following is an abstract: —

"In thinking and speaking of substances sensitve to light," says Mr. Osborn, "photographers and others are apt to remember only the haloid salts of silver; chromic acid, under restraint, acting on organic matter; asphaltum, and a few salts of iron and platinum; which short catalogue does, in fact, include all the sensitive bodies used in practical photography." But, as every one knows, this list may be indefinitely extended (if the degree of sensitiveness be disregarded), and Mr. Osborn has prepared a number of specimens to show such extension in certain directions. Broadly, he says, the results should not be regarded as new, though in the manner of their preparation and presentation some novelty may be claimed for them.

Three specimens were prepared to show colored commercial paper which had been bleached by light, and which give, therefore, a negative when exposed under a negative. On other sheets exposed, papers colored for the purpose with eocine and methyl violet are shown, and they establish the fact that these colors, under the luminous influence, give rise to colorless compounds.

"The duration of the exposures required to produce these photographic effects," says Mr. Osborn, "is very considerable when the change is carried to its maximum; varying from twenty to thirty-five or forty hours in direct sunlight, which is the only kind of exposure employed in the experiments. Indications of photochemical action are, however, visible in much less time. A piece of eocine paper exposed under two strips of black lace showed a faint positive after half an hour; also a piece of methyl violet paper, similarly exposed, showed gradually increasing strength of the positive after one, two, and three hours.

"The fact that printing and writing papers become brown by age is familiar to most persons; but that this change is essentially photographic is not a common belief. Pieces of newspaper were taken from the New York *Tribune*, Baltimore *Sun*, and Washington *Evening Star*, and photographic images were impressed upon them by simple exposure under a dense negative. These papers were subjected to no preparatory treatment, establishing the fact that the newspapers we read daily are printed on papers sensitive to light, and adapted for the production of positive pictures.

"Pieces of white pine wood of different qualities were prepared, upon which photographs were produced by exposures under stencil negatives made by cutting openings in tinfoil and pressing it into close contact with the surface of the wood by means of a plate of glass properly clamped thereto. The exposure required to produce these photographic images varies from thirty to fifty or sixty hours. On a piece of poplar the picture was produced in twenty hours; for it seems probable, that, of all the woods in common use, poplar is the most sensitive, and gives the darkest color when fully exposed. It seems probable that the darkening of wood, which is very commonly though rather vaguely attributed to the action of the air, is related to the photographic effect obtainable on printing-papers. These are now hardly to be had without an admixture of wood-pulp; and the present inquiry, inasmuch as it proves the phenomena to be strictly photographic, may have a practical bearing if it points to means which will keep printing-papers white indefinitely."

The bleaching action of light upon a dried leaf is shown by one specimen; and by another, the fact that a piece of parchment, though substantially white, becomes a little whiter where the light has acted. As far as it goes, this would tend to show that the "yellowing of parchments by age" is not a photo-chemical process. The parchment had a very long exposure.

"As connected with this general subject," continues Mr. Osborn, "I would call to mind the investigations of Mr. Thomas Gaffield of Boston, who established conclusively, more than twenty years ago, the slow effect of light on colorless glass in gradually giving it color, sometimes pinkish and sometimes yellow, the former being apparently due to a re-oxidation of the reduced manganese employed to counteract the iron. These changes often require years for their completion.

"Experiments only just completed tend to show that pure cellulose in the form of the finest filtering-paper is not sensitive to light; at least, a constant exposure in a horizontal position to diffused and direct sunlight failed in two weeks to produce any perceptible change in color. On the other hand, the same filtering-paper colored with picric acid, and similarly exposed for the same time (about one hundred and forty hours of diffused and direct sunlight), gave a coloration as before, when sized and calendered paper of the best quality was treated with the acid.

"Simultaneously with the above exposures, another was made of the same duration and in the same way. This was the presentation of a thin stratum of commercial picric acid on glass to the same illumination as that already mentioned, under a stencil tinfoil negative and a plate of glass covering the same. The picric acid was darkened, as before, very decidedly, though it would be difficult to exhibit the results in a satisfactory way by means of a specimen."

Yellow-Fever and Bad Sanitation.

Surgeon-General Hamilton has just published the reports of several of the government inspectors who were detailed to visit the cities and towns of Florida, and ascertain their sanitary condition and whether yellow-fever prevailed in them or not. Among these reports is that of Dr. J. L. Posey upon his visit to Macclenny, a small town, of about six hundred inhabitants, in Baker County, in which the fever was epidemic. Here is what he says about the sanitary condition of the place: —

"The general appearance of the town, which consists of perhaps a hundred stores and dwellings scattered over a rather large area, indicated a very wretched sanitary condition. The streets along the railroad-track, as well as others, were covered with heaps of decaying sawdust, and garbage of every description spread over them, drains obstructed, and open lots overgrown with weeds and rank vegetation. The floors and platforms of the depot-buildings, passenger and telegraph offices, and their vicinity, were covered with lime, which had recently been thrown broadcast. A further stroll through the town revealed a similar deplorable sanitary state, — the steps and front galleries, and porches and premises, of residences, lavishly sprinkled with lime, and the yards filled with accumulated garbage. No organized measures had been adopted by the local health authorities to even ameliorate, much less correct, this unsanitary state of their town.

"The site of the town is a low, flat, sandy plateau, without sufficient elevation to give effective drainage; the surrounding pine-forests being interspersed with a series of marshes and alluvial basins. No attention had been given to the removal of excreta or their proper disinfection. The water-supply is generally obtained from wells at a depth of fifteen or twenty feet, and is of a quality which I consider very unwholesome, having experienced personally its disagreeable effects. The atmospheric condition resulting from such foul surroundings was fully prepared to propagate the infectious material, which had been already introduced into the town, and had been gradually developing since the 1st of August.

"I went from house to house, and found the sick and dying huddled together in small rooms, with windows and doors closed, the floors sprinkled with chloride of lime, carbolic acid, and a variety of other disinfectants. The oppressive odor of disinfectants mingling with the close atmosphere of the sick-rooms, laden with the emanations from the excreta and ejecta of the patients, together with the dreadful visages of the dying, was shocking to every sense, and the scene well calculated to appall the stoutest hearts. I have seldom witnessed a more pitiable and melancholy sight than that presented to my view in my house-to-house inspection through this desolate scourge-swept town. As I returned to the hotel in the evening, I met many whose pale, wan features, languid air, and step marked them as convalescents from the disease, and others who, with anxious look, approached me, and in whispered tones asked to know my opinion of the prevailing fever. I told them that they must escape with the rising sun, or, remaining, fall victims to yellow-fever.

"A late report shows that there have been 189 cases out of an actual population remaining of 195, the deaths being 21 whites. Of the above number, 160 were whites and 29 colored. There are now sick 11 white and 8 colored."

Dr. Posey himself contracted the yellow-fever at Macclenny, but has since recovered.

Comment upon such a report as this is unnecessary. Yellow-fever is a disease that seeks filth and bad sanitary conditions, and, wherever it finds these and an unacclimated population, it is certain to become epidemic. Its whole history in this country proves this; and especially was this illustrated in the terrible experiences of Galveston about twenty years ago, of Shreveport a few years later, and, more recently, of Memphis. Yellow-fever never became epidemic where the sanitary conditions were good, although the germs of the disease have frequently been introduced into them. It is probable that the sanitation of Jacksonville is much better than that of the cities named was at the time the scourge swept over them; and this, it is believed, accounts for the mild form of the fever there, and the low rate of mortality.

The Human Heart an Electrical Battery.

The discovery announced in the following brief notice has greatly interested the scientific men of Washington, who are looking for fuller reports in the British scientific journals. This brief article appeared in the *Pall Mall Budget* of Oct. 4.

"The most important of the inaugural addresses at the hospitals was Dr. Waller's at St. Mary's, on his discovery of electrical currents caused by the pulsation of the human heart. The researches which Dr. Waller described have occupied him during the last four years; and the record was interesting, he thought, as an actual example of what goes on in physiological laboratories, and correction of 'that most unfortunate and mischievous error that they are chambers of horrors.' But more interesting still are the results of the researches themselves; for if in each human heart there be indeed an electrical battery, then developments in the art of electricity may in time become possible, beside which Mr. Edison's wonderland will seem commonplace."

Derelicts on the Ocean.

One of the most interesting subjects to be discussed by the International Marine Conference in Washington next spring will be "the destruction, or at least the frequent reporting, of dangerous derelicts." The fullest and most valuable information in regard to drifting wrecks, their courses and location, now furnished anywhere, is given on the monthly Pilot Chart issued by the United States Hydrographic Office. Numerous reports are received daily from the captains of vessels; and when the latest facts are plotted, and represented graphically upon the chart, captains of vessels leaving port are able to see at a glance just about where on their voyages they may expect to encounter these dangerous obstructions.

When one of these derelicts drifts into the path followed by many vessels, the danger is greatly increased, and remains until the wreck breaks up or drifts into unfrequented parts of the ocean. The Pilot Chart for October shows the very interesting history of the derelict schooner, 'W. L. White.' She was wrecked off the Delaware capes in the great March blizzard, first drifted south and then north-east, and by the last of March was found in the track of the transatlantic steamers, where she remained six months, drifting slowly north as the summer months went on, and as the steamers changed their tracks to the north. From March 13 to Sept. 19 she was reported thirty-eight times. In twenty-three instances the reporting vessel passed near enough to read her name. On May 30, three vessels 'fell in' with her; June 17, two; and Aug. 7, two. Of the thirty-eight vessels which reported passing her, twenty-eight were transatlantic steamers, and were, no doubt, travelling at high rates of speed when they passed her, and did not see her until she was close by. The awful results of a collision on any one of these occasions can better be imagined than described.

Icebergs frequently give notice of their near approach by the

falling temperature of the air, but a drifting wreck gives no such timely warning of its dangerous neighborhood. This danger is especially great in the night, in foggy or thick weather, and when the derelict is bottom-up or deeply submerged. An instance of narrow escape was the experience of the steamship 'Louisiana,' Sept. 19. While steaming at fourteen knots an hour in the Gulf of Mexico, she passed within fifty feet of a vessel two hundred feet long, bottom-up.

It is hoped that the conference will devise some plan to rid the ocean of these obstructions, or, at least, of the most dangerous of them.

The "King Devil."

In August, 1879, Prof. Lester F. Ward, while returning from a hunting-excursion in the North Woods, discovered near Carthage, N.Y., a new variety of *Hieracium* (house-leek), of which he obtained two specimens. The next day, after a long search, he found on a farm at Evans Mills — a small village about ten miles from Watertown — large colonies of the same plant. The individuals were many of them smaller and slenderer than, but there was no doubt that they were of the same species as, the specimens secured the day before. He secured a great number of the specimens, and remarked to his companion, that, unless the farmers of that region adopted some measures to destroy that weed, it would give them much trouble in the future.

On his return to Washington, Professor Ward identified his specimens as belonging to the species *Hieracium prœaltum*, a variety of house-leek very common, and a great pest to farmers in many parts of Europe, but little known in America.

Last summer Professor Ward visited St. Lawrence County again, and one of the first things he was informed of was the appearance, six or eight years ago, and the rapid spread since, of a weed they called the "king devil." Professor Ward at once identified it as the novel variety of house-leek he had discovered during his former visit in that neighborhood, and, of course, recalled to mind the warning he then uttered. When the king devil once gets into a field, it completely covers the ground with its continuous green leaves, preventing the growth of any other plant or weed. It took such complete possession of one field of thirty acres, that there was absolutely nothing else on it — there could be nothing else.

Inquiry as to the local origin of the king devil traced it to the farm where Professor Ward had found the colony in 1879; and here, therefore, was the nest in which was hatched one of the worst pests the farmers of the United States have ever had to encounter, and from which it has spread over the country. In the region where it first appeared it has already extended over a belt of country fifteen miles wide, the length of which Professor Ward did not ascertain. It has been reported thirty miles west of Kingston, Canada, and in other places.

Various methods of eradicating the king devil have been suggested, but none of them have proved effective except the thorough salting of the land. This, of course, is expensive, and destroys all other vegetation as well as the noxious weed against which it is directed; but the field can be restored, and, while the king devil has possession of it, it is of no use whatever to its owner.

An Apparatus for studying Insects under Ground.

Prof. H. J. Comstock of Ithaca has, by a very simple invention, greatly extended the field of investigation for entomologists. He has made it possible for them to see insects under ground, and study their subterranean habits. The apparatus consists of a narrow frame made of wood, the two broad sides enclosed with glass. A sheet-iron shutter or screen is fitted to slide before the glass on each side, and, at ordinary times, exclude the light. Two sides and the bottom of the box thus formed are therefore narrow, and composed of wood, while the other two sides are broad pieces of glass. The top is open.

This box is filled with earth, and any plant that may be selected is set out in it. The insect living under ground that is an enemy of this plant, and whose habits it is desired to study, is also placed in the earth. The sides of the box are then closed with the screens, so as to secure the same conditions in the soil in the box as under ground in nature. From time to time, as it is desired to investigate, the screen on one side is temporarily removed, and through the glass the movements of the insects may be observed, changes in their development noted, and important discoveries may be made.

The apparatus is made of all sizes and various shapes, so as to adapt it to any special investigation that may be undertaken. Professor Comstock has one at Ithaca so large that he keeps it in a hole in the ground, and raises and lowers it by means of a rope attached to a pole. It is admirably adapted to the study of the roots of growing plants, and may be so modified as to expose to view the underground habits of small animals that burrow.

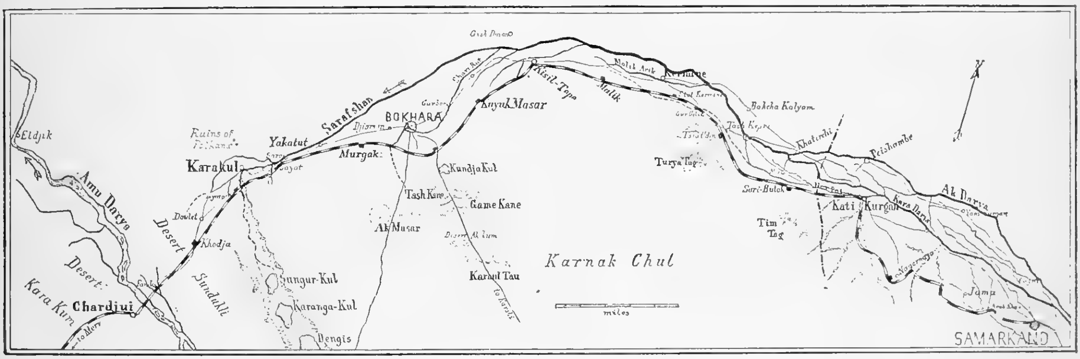
COMMERCIAL GEOGRAPHY.

Bokhara and the Transcaspian Railroad.

THE rapid changes brought about by the construction of the Transcaspian Railroad in Bokhara and Samarkand form the subject of an interesting paper by Dr. O. Heyfelder, which was published in the October number of *Unsere Zeit*. On Jan. 18, 1888, the great bridge across the Amu Darya at Chardjui was completed, and on May 27, Samarkand was reached. The railroad runs in a north-easterly direction from Merv to Chardjui, and, a short distance south of the latter place, enters the territory of Bokhara. Near Karakul it reaches the Sarafshan, which it ascends. Samarkand became a Russian province in 1868, but until recently it was almost isolated, large deserts being situated north-west and south-west of it. A road connects the city with Tashkent, from which place it took twenty-one days to reach St. Petersburg. The telegraph from Samarkand to St. Petersburg followed the same road. Since the opening of the railroad the state of affairs in the whole valley of the Sarafshan has greatly changed. The people of Bokhara were at first opposed to the enterprise, as it brought the country still more under Russian and Christian influence. For these reasons they insisted upon the road passing the city of Bokhara at a distance of several miles; but it seems that after the road was once opened they quickly acquiesced in the new state of affairs, and the country is now open to European, or rather Russian, influence. Lady physicians, who practise in Samarkand and Tashkent, have had a great influence upon the population, and the medical staff of the railroad is doing good work in Bokhara. Heyfelder believes that their influence will be sufficient to improve the hygienic conditions of the filthy cities of that country. European manufactures are introduced by branch offices of Russian houses, and particularly through their establishment European influence is gaining greater strength. The first of these branch offices was founded in Bokhara in 1874, after the ratification of the treaty of commerce; but the greater number were established after the completion of the railroad to Merv, and after its continuation to Samarkand had been decided. At present they are not confined to the capital, but Russian merchants are found in every city of the country. The extent of its trade will be understood from the fact that merchants from Bokhara visit annually the great fair of Nischnii-Novgorod to sell the produce of the khanate. Silk manufactures from Samarkand are sold in St. Petersburg, Moscow, and Kharkow. Sheep are purchased in Karakul, and transported by rail to the Dnieper; lamb-hides are sold to Moscow, lumber to Asia Minor; and carpets from Bokhara are valued all over the Orient. While, according to the treaty, the importation of European manufactures is favored, a wise article prohibits the sale of alcohol in the khanate. Gambling and the use of liquors have been introduced by the Russians into Samarkand, not to the advantage of the natives. It is doubtful whether the influence of the Europeans will have a wholesome effect upon the trades of the people. At present they are skilful potters, turners, embroiderers, and leather-manufacturers. It is, however, a frequent experience that trades of this kind are unable to compete with the cheap products of European machines, and that the introduction of improved methods is accompanied by a decline in native art. Samarkand and Bokhara are dependent upon the Sarafshan, cultivation being possible only by means of irrigation. There exists an admirable and complicated network of canals all along the river; but, of course, no scientific methods of irrigating are used, and consequently a great portion of the available water is wasted. Russian influence will undoubtedly tend to improve the methods applied, and thus the extent of arable land and the value of its produce will

no doubt be greatly increased within a short time. Whatever our opinion of the political institutions of Russia may be, in Central Asia they prove themselves able and energetic civilizers, and their influence upon the vast extent of country east of the Caspian Sea has been highly beneficent.

MINING INDUSTRIES OF NEW ZEALAND. — The report on the mining industries of New Zealand for the year 1887, which has recently been issued, shows the great importance of these industries to the colony. There are nearly 12,000 persons engaged in gold-mining, the average annual earnings of miners being $325, and the value of the gold exported being somewhat less than $4,000,000. About 1,500 persons were engaged in coal-mining, their average earnings being $540. While the value of gold-production has been decreasing continually ever since 1866, when it was more than $14,000,000, the amount of coal has steadily increased, being at present over half a million tons, of which only a small portion is exported. The total value of mineral exports other than gold has made rapid progress during the past ten years, being more than $2,000,000 in value, as compared to $750,000 in 1878. Of special interest is the production of kauri-gum, on which the mining department reports, although it is a vegetable product. This product is the resinous exudation of the kauri-pine (*Dammara Australis*). It is found in deposits which extend more or less over the northern portion of the Auckland Provincial District, in forests, and more extensively in open country. The latter is evidently the site of ancient forests, of which, except the valuable gum, not a vestige remains. The extensive use of the gum as a varnish in America and Europe has for many years led to a large export trade. The value of the export in 1887 was £362,449 (about $1,750,000), or equal to nearly one-half the value of the gold export of the colony for the same year. The search for the gum is engaged in by both Europeans and Maoris; and at certain seasons of the year as many as ten thousand persons are engaged in connection with this industry. The gum-digger's outfit consists of a steel-tipped prod, a spade, and a bag, and, although he cannot indulge in the dreams of sudden wealth which fascinate the gold-seeker, he is sure, at least, of always averaging fair wages. Since the commencement of this industry in 1853, the quantity exported to March 31, 1888, represents a value of more than $22,000,000.



LOWER COURSE OF THE SARAFSHAN.

HEALTH MATTERS.

TONICS AND BITTERS. — In a former number of *Science* we called attention to the excellent work done by Dr. B. F. Davenport, chemist to the State Board of Health of Massachusetts, in the examination of foods and drugs. Recently he has been analyzing the tonics and bitters with which the market is flooded. The number of these which have been examined by him is forty-seven. Of this number, forty-six contain alcohol, in quantity varying from 6 to 47.5 per cent, 21.5 per cent being the average. One of the tonics, advertised as "not a rum drink," contains 13.2 per cent of alcohol. Another, admitted to contain Marsala wine, contains as much alcohol as that wine. A coca beef tonic, advertised as made "with sherry," contains 23.2 per cent of alcohol, while sherry contains but 18 or 20 per cent. Parker's tonic, claimed to be a purely vegetable extract, "stimulus to the body without intoxicating," contains 41.6 per cent of alcohol. Whiskey and brandy contain but 50 per cent of alcohol. The advertisement of this tonic says, "Inebriates struggling to reform will find its tonic and sustaining influence on the nervous system a great help to their efforts." Schenck's seaweed tonic, said to be distilled from seaweed, and to be perfectly harmless, contains 19.5 per cent of alcohol; Baker's stomach bitters, 42.6 per cent; Hoofland's German bitters, advertised to be purely vegetable, and free from alcoholic stimulant, 26.5 per cent; and Hostetter's stomach bitters, 44.3 per cent. Kaufmann's sulphur bitters contains no sulphur, and is advertised to contain no alcohol, but was found by Dr. Davenport to contain 20.5 per cent. Richardson's concentrated sherry-wine bitters contains 47.5 per cent, 2.5 less than whiskey and brandy. Walker's vinegar bitters contains 6.1 per cent; and Copp's White Mountain bitters, about the same quantity.

CHEESE-POISONING. — From the *Sanitary Inspector* we learn that already this season there have been reported many cases of cheese-poisoning, particularly in Ohio. The State Board of Health of that State was, within a short time, notified of many cases, distributed as follows: at Urbana, sixty-five cases; Mansfield, fifty; West Liberty, thirty-five; Mutual, fourteen; Marion, fifty. The symptoms were vomiting, accompanied with much pain in the stomach, and, in many cases, violent purging. The sickness usually lasted from twelve to forty-eight hours, and great prostration was a marked feature, with syncope in some cases. No deaths occurred. Tyrotoxicon is suspected.

THE TYPHOID-BACILLUS. — Dr. C. Seitz, after a careful study of the relation of Eberth's bacillus to typhoid-fever, comes to the following conclusions: 1. Typhoid-fever is produced by the immigration of the typhoid-bacillus. The specific bacillus is found exclusively and is present without exception in typhoid-fever. Inasmuch as typhoid-fever is an exclusively human disease, the negative experiments on animals should not be brought in opposition to the influence of the bacillus as the cause of the fever. 2. The bacillus finds in the intestinal canal of man the conditions for its multiplication, and from there, without penetrating deeply into the tissues, can endanger the organism with its virulent chemical products. 3. The bacillus leaves the intestinal canal (rarely the *viæ urinariæ*) of the typhoid patient in a condition capable of infecting. 4. On account of its essential biological qualities, it can retain its vitality a long while in the earth (here the saprophytic, or common putrefactive bacteria, impede its multiplication). 5. In water it can live at least a week; in ice, much longer. 6. In milk it can undergo a notable multiplication. 7. The principal means by which the

typhoid-bacillus is transported, are contact with the typhoid-dejections, the use of water or milk contaminated with the bacilli, or of various substances infected through the medium of the air.

MENTAL SCIENCE.

Intellect in Great Britain.

THAT the study of the origin, distribution, and characteristics of eminent men both lends a peculiar charm to history and at the same time furnishes the key to many of the influences that shape civilization, is a thought that has inspired many a student. The temperaments and training of different writers have led them to attack the problem from various points of view. In our own day much interest has been exhibited in the study of great men from what might be called the 'natural history' point of view, — a view that emphasizes the importance of average results in contradistinction to a minute study of the individual as individual; that inquires into the influences of ancestry, of environment, physical, mental, and moral. M. de Candolle's study of scientists, and Mr. Francis Galton's work upon 'Hereditary Genius,' are eminent instances of work in this field. It is as a minor contribution to this study that Dr. A. Conan Doyle (*The Nineteenth Century*, August, 1888) analyzes the geographical distribution of eminent men in the Great Britain of to-day. Such an analysis may suggest the influences of climate, as well as of educational, political, and other artificial surroundings.

The first question is, naturally, who are the eminent men? Dr. Doyle does well in requiring as a test of eminence the appearance of the name in a standard biographical dictionary, such as the 'Men of the Time,' excluding as far as possible all merely local celebrities. He thus finds about 1,150 men, "who have, during the latter part of the Victorian era, attained eminence in literature, poetry, art, music, medicine, sculpture, engineering, law, and other intellectual walks of life." Of these, 824 were born in England, 157 in Scotland, 121 in Ireland, and 49 were born abroad (it should be added that an appreciable number of men are of immediate Irish or Scottish extraction, though born in England). Comparing these numbers with the populations of the three countries (including Wales under England), we find that Scotland ranks first, with 1 man of distinction to 22,000 of the population; England next, with 1 to 31,000; and Ireland last, with 1 to 49,000. If we take Wales separately, England's proportion becomes 1 in 30,000, and Wales foots the list with but 1 in 58,000.

The showing of London, as the great intellectual centre, is a chief point of interest. Of the 824 Englishmen, 235 are of London birth, which, placing the population of London as one-seventh of that of England, gives London 1 celebrity to 16,000, and the provinces not more than 1 in 34,000. This shows at once how strongly the brightest intellects are attracted to the metropolis. But Dr. Doyle points out, that while London stands so well as regards celebrities, if we confine our attention to men of first-rank ability, the provinces show a superiority. While not re-enforcing this statement with percentages, he asks us to remember that Darwin, Owen, Hooker, and Tyndall; that Leighton and Millais; that Herbert Spencer; that Tennyson, Carlyle, Freeman, Lecky; that Dickens and 'George Eliot,' — are all country-born.

Continuing this analysis, it is found that London is especially strong in the production of artists and scientists, — both branches in which organized educational institutions are of supreme value. The following table may serve for a partial comparison of London with the counties to the north and south: —

	Total Celebrities.	Authors.	Scientists.	Artists.	Poets.	Musicians.
London.	235	66	34	37	13	10
North of London	227	64	30	14	9	8
South of London	200	66	18	13	9	4

The remaining Londoners include 20 theologians, 12 medical men, 8 lawyers, 5 sculptors, 4 soldiers, 4 seamen, and 22 who must be classed as miscellaneous.

The detailed analysis of the standing of the several counties is hardly of interest to an American public. In the southern counties there appears 1 celebrity to 23,000 of population. The county of Hampshire stands best, with a ratio of 1 in 13,000. The midland counties are unmistakably and regularly less fertile intellectually than the southern counties, producing only about half the proportion of celebrities, or 1 in 41,000. Physical surroundings furnish no clew to this difference; and Dr. Doyle regards it as racial, as due to a purer and better-developed stock. The four eastern counties of Lincolnshire, Norfolk, Suffolk, and Essex stand even higher than the southern, with a ratio of 1 in 22,000. It is interesting to note that Suffolk is the county of famous women, producing Agnes Strickland, Jean Ingelow, Miss Edwards, and others. In the northern counties the statistics do not bear out their reputation for sagacity, making only 1 in 43,000 celebrated.

"All English results for the larger divisions of the country are put in the shade by the lowlands of Scotland, where 1,800,000 people yield 97 celebrities, or 1 in 18,500. These figures put that portion of Scotland which lies between the Forth and Clyde on the north, and the English border, in the proud position of having reared a larger number of famous men in the later Victorian era than any other stretch of country of equal size." "The single town of Edinburgh has produced no less than 46 worthies, which, when compared with the population, gives an average of 1 in 5,500, nearly three times as high as that of London." The north of Scotland furnishes 31 names, in which the Aberdeenshire district ranks best.

The following table for Ireland shows that Dublin can well hold its own with any English city in its contribution to English worthies: —

	Population.	Celebrities.	Ratio.
Town of Dublin	400,000	45	1 in 8,500
Rest of Leinster	900,000	12	1 in 75,000
Munster	1,390,000	29	1 in 47,000
Connaught	846,000	7	1 in 120,000
Ulster	1,800,000	27	1 in 66,000

In reviewing these results, Dr. Doyle notices, that, if a line be drawn through the centre of Lincolnshire, the poetry of the nation will be found on the south of it. The list includes Tennyson, Swinburne, Browning, William Morris, Matthew Arnold, Sir Edwin Arnold, Gosse, and a host of lesser lights; while the few above this line are readily counted. "It may be generally stated, that, with a few notable exceptions, music, poetry, and art reach their highest development in the south, while theology, science, and engineering predominate in higher altitudes." Again: the towns have a greater intellectual activity than the country, and the agricultural districts are usually richer in great men than manufacturing or mining districts.

SPEECH AND MUSIC IN DISEASE. — In those strange mental disorders in which one of the factors of speech is lost, it is a general law that the most recently organized function, the one representing the higher stages of civilization and education, is the one first to be affected. A German alienist (*Neurologisches Centralblatt*, Sept. 15) has recently described cases admirably illustrating the truth of this generalization. Expression by gesture, without the use of symbolic words, is a more primitive form of expression than is regulated speech. Similarly the expression of emotional states by mere sound, by music, is an earlier acquisition than speech. In 16 cases of aphasia, 11 showed marked inability to express their thoughts by the ordinary vocal articulation. The defect was not a loss of intelligence or a paralysis, but the association between the ideas and the feeling of the vocal mechanism when uttering the sounds expressing such ideas is lost. In these eleven cases the power of singing and understanding melodies was retained. These patients, too, retained the gesture-language and full powers of emotional expression. They could automatically repeat what was spoken to them just as well when this made sense as when it did not. In the other five

cases, however, the loss of speech brought with it the loss of musical expression, though it was definitely ascertained that at least two of the five were musically inclined. Whether these differences depend on individual education, upon different locations of the affected mental centres, or upon the intensity of the affection, remains to be determined.

ELECTRICAL SCIENCE.

Electric Conductors for Alternating Currents.

ONE of the most practical and useful papers read before the last meeting of the British Association was one by Sir William Thomson, in which he calculated the distribution of a rapidly varying electric current in a conductor.

It is well known that an electric current which has reached a steady condition in a wire is uniformly distributed through its section, and the resistance of the wire varies inversely as the area. But with rapidly varying currents the case is different, and the difference may be understood from an analogy to liquid motion, due to Mr. Heaviside. In the first place, Professor Poynting has shown that the electrical energy which appears in a wire carrying a current is not conveyed directly through the wire from the dynamo or battery supplying it, but it is first conveyed to the medium surrounding the circuit, and then enters the wire at every point from the medium. According to Mr. Heaviside, the state of the case may be partially represented by a hollow tube in a tank of water. If we move the tube slowly in one direction, and if the tube be long in proportion to its diameter, then in a short time all of the particles of water in the tube will be moving with it, at the same velocity. This represents a steady current; and it partly illustrates Professor Poynting's idea, for the motion of the water is due to the friction of the tube at every point of the boundary, not to a pressure along the tube such as would be produced by a piston in it.

If, instead of giving a steady motion in one direction, we move the tube backward and forward rapidly, we will have the outer layer of water moving nearly as fast as the tube, the velocity decreasing as we proceed inward; and, finally, if we make the oscillations short enough and rapid enough, the inner layers will not move at all, only the particles near the outside taking part in the motion.

Now, this is exactly what happens in the case of an electric current which changes very rapidly. If the change is rapid enough, the current — corresponding to the velocity of the particles of water — will be mainly near the outer surface of the wire, and it might happen that there is no current at all at the axis. The effect of this is to increase the apparent resistance of the conductor, causing a greater loss from heating, and a greater fall of potential, than ordinary calculation would give.

Now, although these facts have been pretty well known since Maxwell's treatise on electricity and magnetism was published, yet very few people suspected that they would have any practical bearing on alternating systems of electrical distribution. Sir William Thomson, however, in calculating out some numerical examples, obtains results which show that in the alternating system as ordinarily used a considerable portion of the inside of the conductors does not carry any current at all, and is useless. For example: with the period of alternation used by the Westinghouse Company in the United States, in the neighborhood of eight thousand a minute, the current does not penetrate so much as one-eighth of an inch into the wire. The size of conductor used for distributing current for even a moderate number of lamps — say, a thousand lamps at a mean distance of a mile — is much beyond this limit of semi-diameter, in the case cited being more than half an inch in diameter. The result is a much greater loss by heating than is usually calculated, and a fall of potential that in some cases interferes with the brightness of the lamps. In order to make these effects a minimum, it would be necessary to use for conductors either thin, hollow tubes, or thin, flat strips of metal, and especially is this the case when a large number of lamps are to be supplied. The expense of the tubes would in all probability make their use impracticable; so that in future we may expect to see any extended alternating-current distribution either with copper strips as conductors, or with a number of comparatively small wires. It should be pointed out as an illustration of the value of a sound mathematical training in applied electricity, that the best form of conductor for any particular case of distribution, whether strips, a single wire, or a number of wires, can be calculated from obtainable data as to prices. It is the experience of the writer, however, that few electric plants are installed in a way to secure the greatest economy, and much money is wasted needlessly from neglecting to make the necessary calculations.

THE SUN-LAMP. — One of the most attractive of high-power electric lamps is that known in France, where it was invented, as the '*lampe soleil*.' It consists of a wedge of some refractory material, marble preferably, held between two carbon rods that are inclined to one another. This is set in a cavity in a marble block held in an iron frame. A very simple lamp of this kind can be made by boring a couple of holes in a block of marble so they are slightly inclined and approach within about a quarter of an inch at the bottom, and putting in two carbon rods. If this be supplied with an alternating current to form an arc between the carbons, the marble will be heated, and will give off a brilliant, mellow light of a golden tinge, very different from the piercing but rather disagreeable light of the ordinary arc-lamp. A very high candle-power can be obtained from it, and it is absolutely steady. The objections to its use arose from the facts that it was not certain to start up automatically when the current was turned on, and it required alternating currents instead of direct. This was some years ago, before alternating currents had been largely introduced. From the fact that a larger surface has to be heated than in the ordinary arc-lamp, and the surrounding material conducts away a considerable amount of heat, the lamp is not so economical as are arc-lamps. In the last few years alternating-current distribution has been developed, and now an English syndicate is being formed to introduce a modified sun-lamp, in which many of the objections of the old form have been removed. The lighting is now automatic and certain, and the lamp can be used either with continuous or alternating current generators. For lighting halls, galleries, etc., and in general for interior illumination, this modified lamp should have an extensive field.

THE ELECTRIC LIGHT VS. GAS IN FRANCE. — Messrs. Brun & Co., owners of a silk-manufactory at St. Clamond, give some particulars, in *Annales Télégraphiques*, as to the comparative cost of gas and electric lights, obtained from two years' experience in their works. The original lighting of the factory was by 540 gas-jets, consuming 20,000 francs' worth of gas annually. These were replaced by 600 incandescent lamps, — one-half Edison, the rest Swan, — the average life being 1,200 hours. The current is supplied by an Edison dynamo of 450 ampères and 100 volts. It has worked for 18 months at an average of 15 hours per day. Part of the factory works night and day, and some of the lamps work 3,600 hours a year, while others are only used for 600 hours. The following are the expenses: —

Cost of 90-horse-power engine, with fittings	32,000 francs.
Dynamo, conductors, lamps, etc	23,000 "
Total	55,000 francs.

The yearly cost is, —

10 per cent sinking fund	5,500 francs.
5 " " interest	2,750 "
Increase in coal-consumption	1,200 "
" " oil, etc	250 "
Renewal, 600 lamps	2,700 "
Total	12,400 francs.

The saving is 7,600 francs per annum. The item of labor is not included, as the force of mechanics was not increased on putting in the installation.

BOOK-REVIEWS.

The Land beyond the Forest. By E. GERARD. New York, Harper. 12°.

MRS. GERARD has collected her observations during a two-years' life in Transylvania in the present attractive volume, and greatly enhanced the value of her descriptions by adding to her own experiences information from other sources, which became

full of life in her mind, that is so deeply impressed by the wild beauty of this remote province, and by the strange admixture of races by which it is peopled. The authoress describes the Saxons, Roumanians, and gypsies very fully, while she gives only a passing glance to the Hungarians. It is probably because she became more intimately acquainted with the former, and studied their customs and beliefs more thoroughly, that she confines herself to the description of this part of Transylvanian life. The large amount of interesting and valuable ethnological information collected by the authoress deserves our full admiration. Customs and beliefs which have survived from the ancient days of paganism or from the superstitions of the middle ages offer a peculiar interest to the student of the history of civilization; and the present volume contains much that is worth a thorough study, and that will interest the thoughtful reader. The descriptions of the country and of its inhabitants are vivid, and made more impressive by numerous illustrations, which are the more welcome, as Transylvanian scenery is little known, and has not yet received much attention by artists.

Manual of Chemistry. By W. SIMON. 2d ed. Philadelphia, Lea Bros. & Co. 8°.

THIS manual is designed to be a guide to lectures and laboratory work for beginners in chemistry, and a text-book specially adapted for students of pharmacy and medicine. The contents are divided into seven parts. The first part treats of the fundamental properties of matter, extension or figure, divisibility, gravitation, and porosity. In the second are considered the fundamental principles of chemistry, including chemical divisibility, the laws of chemical combination, the determination of atomic weights, the decomposition of compounds, and some general remarks regarding elements. Non-metals and metals, with their combinations, are next discussed. Then follow analytical chemistry and the consideration of carbon compounds or organic chemistry, while the last part is devoted to physiological chemistry. As a help in laboratory-work, experiments are described which may be readily performed by students with a small amount of apparatus. Professor Simon, in common with other teachers, has often noticed how difficult it is for beginners to familiarize themselves with the variously shaded colors of chemicals and their re-actions; and, in order to remove this difficulty as far as possible, he has introduced into the manual seven plates, which contain fifty-six representations of the most important color-changes. The coloring is remarkably correct, and will undoubtedly do much to overcome the difficulty which these plates were designed to meet. The book is in other respects fairly well illustrated. The typography and general make-up of the book are excellent, and we have no doubt that it will meet the same favor which was accorded to the first edition.

PUBLISHERS' FALL ANNOUNCEMENTS.

Estes & Lauriat.

For young people: 'Zigzag Journeys in the Antipodes,' a volume which takes the reader to Siam, and tells him of the interesting animal-worship of the country; 'The Knockabout Club in the Antilles,' by F. A. Ober; and 'Hunting in the Jungle,' from 'Les Animaux Sauvages,' by Warren F. Kellogg. 'The Pioneers of the Alps: A Collection of Portraits of the Leading Guides of the Oberland, of the Valais, of Savoy, and of Piedmont,' by C. D. Cunningham and Captain Abney. 'Fingers and Fortune: A Guide-Book to Palmistry,' by Eveline M. Farwell. 'The Pocket Encyclopædia,' containing 1,206 columns, upwards of 25,000 references, and numerous plates (published by subscription only). Editions de Luxe of standard and fine art works now issuing or soon to be issued (to subscribers only): 'History of Greece and of the Greek People, from the Earliest Times to the Roman Conquest,' by Victor Duruy; and 'Birds in Nature,' by R. Bowdler Sharpe.

Thomas Nelson & Sons.

'David Livingstone, the Story of his Life and Travels,' with many illustrations; 'The Emperor of Germany,' William I.: A Life Sketch,' by Athol Mayhew, with 8 full-page illustrations by R. Caton Woodville; 'Little Arthur at the Zoo, and What he saw there — Birds,' by Mary Seymour; 'The Story of the Niger: A Record of Travel and Adventure from the Days of Mungo Park to the Present Time,' by Robert Richardson; 'India, Pictorial and Descriptive,' by the author of 'The Mediterranean,' illustrated with 112 fine engravings; 'The Nineteenth Century: A History,' by R. Mackenzie (new edition, revised and enlarged); in the Pen and Pencil Series, 'Irish Pictures, drawn with Pen and Pencil,' by Rev. Samuel Manning, LL.D., Rev. S. G. Green, D.D., and others; 'Great Authors, from Goldsmith to Wordsworth,' with biographies and copious selections from their writings; 'Great Authors, from Macaulay to Browning,' with biographies and copious selections from their writings.

Frederick A. Stokes & Brother.

'The Golden Age of Patents,' by Wallace Peck, a most amusing parody on Yankee inventiveness, filled with clever skits, well illustrated by various humorous artists; 'Oysters and Fish,' by Thomas J. Murrey, a most complete and important work on the subject, deemed by the author himself as one of his most valuable books, and containing over 150 recipes and much interesting information regarding shell-fish and fish of many kinds; 'Eight Songs of Horace,' edited by George E. Vincent, a remarkable novelty, which has received the most careful attention in every detail, being an attempt to reproduce with all possible exactness a Roman book of the classic period; 'Favorite Birds, and What the Poets sing of Them,' edited by Josephine Pollard; 'The Game of Chess,' an entirely new edition, based upon Staunton's great work, and containing all essential parts of it; in the Lives of the Presidents Series, 'Grover Cleveland,' by William O. Stoddard; 'Madonnas by Old Masters,' being as exact facsimiles of the originals as it is possible to make by any process resulting in a copper or steel plate (the publishers know of nothing of their general nature which copy the same paintings and can compare with these valuable plates).

Miscellaneous.

The ninth volume of 'Alden's Manifold Cyclopedia' (New York, J. B. Alden) is out. —— 'Pen and Ink: Papers on Subjects of More or Less Importance,' by Brander Matthews, will be issued shortly by Longmans, Green, & Co. It contains essays on Locker and Austin Dobson, on war songs and short stories, on the antiquity of jests, and on the ethics of plagiarism, and also the first serious paper yet written on the genesis and practice of the American game of poker. 'B.C. 1887' is the odd title of a volume of travels in British Columbia, by the authors of 'Three in Norway,' Messrs. Lees and Clutterbuck, to be issued this month by the same publishers. Although humorous in manner and full of anecdote, 'B.C. 1887' is an account of a serious expedition of two young Englishmen who came to America with a view to settling in the Dominion. —— D. Appleton & Co. will publish on or about Nov. 1 a new volume by Sir John Lubbock, entitled 'On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects.' It will form Vol. LXIV. of the International Scientific Series. The same firm announces 'A Manual of Decorative Composition,' for designers, decorators, architects, and industrial artists, by Henri Mayeux, architect to the French Government, with nearly 300 illustrations; 'A Dictionary of Terms in Art,' elaborately illustrated; 'Nature and Man, — Essays Scientific and Philosophical,' by the late Dr. W. B. Carpenter, with an introductory memoir by J. E. Carpenter; and 'The Folk-Lore of Plants,' by T. F. Thiselton Dyer. —— Charles Scribner's Sons published last week 'Children's Stories of the Great Scientists,' brief biographies of sixteen of the world's great scientists, by Miss H. C. Wright, with 8 full-page portraits. —— Harper & Brothers have ready 'The Boy Travellers in Australasia,' by Col. Thomas W. Knox, a description of the isles of the Pacific; and 'Shoshone and other Western Wonders,' an account of sights and scenery worth seeing in the Far West, by Edwards Roberts, with an introduction by Charles Francis Adams. Messrs. Harper and Brothers announce that John Morley's English Men of Letters Series, which hitherto has been issued in thirty-six volumes, has now been compressed into a People's Edition of twelve volumes. —— Mayor Hewitt's more or less cheerful face adorns the first page of *Harper's Weekly* for Oct. 17. The supplement is devoted to a description, pictorial and otherwise, of 'The United States Coast and Geodetic Survey,' by Henry P. Wells. —— Houghton, Mifflin, & Co.

announce Mr. Hurlbert's book, 'Ireland under Coercion,' which has created so much discussion in Great Britain. —— Thomas Whittaker is about to publish a library edition of Pascal's 'Thoughts,' from the text of Molinier, by C. Kegan Paul. He also begins a new series of illustrated books under the title of 'Whittaker's Home Library.' The first three volumes will be 'Romance of Animal Life,' by J. G. Wood; 'Leaders Upward and Onward,' by H. C. Ewart; and 'Round the Globe,' by W. C. Proctor. —— Robert Clarke & Co. have in press a book by Joseph S. Tunison, of the New York *Tribune's* editorial staff, to be entitled 'Master Vergil: a Series of Studies upon the Mediæval Reputation of the Author of the Æneid.' 'Vergil and the Devil,' 'Vergil in Literary Tradition,' 'Vergil's Book of Magic,' 'Vergil the Man of Science,' 'Vergil the Saviour of Rome,' 'Vergil the Lover,' 'Vergil the Prophet,' and 'Vergil in Later Literature,' are the chapter headings, and give a fair idea of the contents and character of the book. —— Henry Willey, New Bedford, Mass., has just published 'A Synopsis of the North American Lichens, Part II.,' by the late Edward Tuckerman, comprising the *Lecideacei* and (in part) the *Graphidacei*. The work, which was left unfinished at the time of the author's death, has been completed by Mr. Willey, who has also added other lichens from Professor Tuckerman's various works. Students of this interesting and difficult branch of botanical science have now for the first time a handy manual by two of its foremost exponents. Edwin Nelson, Amherst, Mass., will supply the book to the trade. —— D. C. Heath & Co. have begun the publication of a series of leaflets for the guidance of students of English literature of the nineteenth century, prepared by Louise Manning Hodgkins, professor of English literature at Wellesley College. The following English and American authors will be included: Scott, Lamb, Wordsworth, Coleridge, Byron, Shelley, Keats, Macaulay, Dickens, Thackeray, Robert Browning, Mrs. Browning, Carlyle, George Eliot, Tennyson, Rossetti, Irving, Bryant, Hawthorne, Longfellow, Emerson, Whittier, Holmes, and Lowell. The Tennyson, George Eliot, Hawthorne, and Longfellow papers are now ready. —— Cassell & Co. announce a work entitled 'The Truth about Russia,' by W. T. Stead, editor of the *Pall Mall Gazette*, who does not, it is said, share the traditional British attitude of suspicion toward the empire of the north. —— Ginn & Co. will publish in December, in the College Series of Latin Authors (edited under the supervision of Clement L. Smith and Tracy Peck), 'Cicero's Brutus,' edited by Martin Kellogg, professor of Latin in the University of California. In the 'Brutus,' which was composed in 46 B.C., and purports to be a conversation with Atticus and Brutus, Cicero traces the development of oratory among the Romans down to his own time, with critical notices of about two hundred speakers. The long catalogue is relieved of dryness by the dialogue form, the freedom of digression, and by Cicero's fresh and teeming style. Professor Kellogg has edited the work especially for early college-reading. —— J. B. Lippincott Company announce as in press 'The Writer's Hand-Book,' a general guide to the art of composition and style; 'An Elementary Treatise on Human Anatomy' (entirely new edition), by Joseph Leidy; 'A Cyclopædia of Diseases of Children and their Treatment, Medical and Surgical,' edited by J. M. Keating, M.D.; 'Paradoxes of a Philistine,' by William S. Walsh; 'History of the Celebration of the One Hundredth Anniversary of the Promulgation of the Constitution of the United States,' edited by Hampton L. Carson; 'The Clinical Diagnosis of Non-Surgical Diseases by Bacteriological, Chemical, and Microscopical Methods of Research,' by Dr. Rudolf von Jaksch, translated into English by Dr. Cagney. —— 'The Private Correspondence of Daniel O'Connell,' to be published in two volumes in October by Longmans, Green, & Co., consists chiefly of hitherto unpublished letters of the liberator, abundantly annotated, and connected by only sufficient narrative to explain their occasion. Although called private, O'Connell's letters, even those to his wife, are chiefly on public topics. There is a peculiar timeliness in the publication just now of this first-hand and personal account of the successful struggle for Catholic emancipation, and of the later ineffectual effort for the Repeal of the Union. —— In *Lippincott's* for November an article of particular interest is Mr. Edgar Saltus's 'Morality in Fiction.' Another article that will be eagerly perused is the 'Extracts from the Diary of John R. Thompson,' compiled by Elizabeth Stoddard. Thompson, a well-known Southern *littérateur*, was sent to London to edit the *Index* on behalf of the Confederacy, and he was thrown with men like Tennyson, Carlyle, Gladstone, Dickens, Thackeray, and many others, of whom he gives entertaining reminiscences and anecdotes. Lincoln L. Eyre's article on 'Corporate Suretyship' is interesting and valuable.

NOTES AND NEWS.

THE topographic work of the arid lands and irrigation survey has been completed at the United States Geological Survey in Washington, and all the parties to be employed this year are already in the field. The hydrographic branch involves some very difficult scientific problems, the solution of which may cause some delay. Among these are the discovery of a method that shall be more accurate than any now employed to measure the volume of water that passes through a river. This is probably among the simplest of the problems. Another is a means of ascertaining the amount of sediment a river carries, and a third is the invention of some method of determining the annual amount of evaporation from the surfaces of the proposed reservoirs.

— General Greely, in his annual report, says that the percentages of successful weather-predictions made by the signal office for the year were 78.4; wind, 75.5; temperature, 74.2; general average, 76.7. The number of cold-wave signals displayed was 1,743, of which 1,240, or 71.5 per cent, were verified.

— Dr. Theodore Gill, at the meeting of the Washington Biological Society last Saturday evening, read a paper on 'The Families of Fishes.' He said that in 1872, after eleven years' study of the subject, he published a list of the families of fishes numbering 244. Subsequent studies have increased this number to 300. Cuvier recognized only 30. At the same meeting Dr. Gill defended his use of the suffix 'idæ' to the Greek or Latin root to designate a family instead of 'atidæ,' the one used by naturalists for a century. He read letters from the most distinguished Greek and Latin scholars in the country, asserting that 'idæ' was grammatically the only proper form. The members of the society who discussed the subject were not convinced by Dr. Gill's arguments and authorities.

— 'Sexual Characteristics of the Lachnosternis' was the title of a paper read by Mr. J. B. Smith of the Department of Agriculture, before the Washington Biological Society at its meeting last Saturday evening. It described a study by the author, last summer, of the June-bug, about which, strange to say, entomologists before knew comparatively little. The study resulted in the identification, among the many thousands of specimens captured in the District of Columbia, of four strongly marked, well-defined species, the female as well as the male of each species being determined.

— In a pamphlet, 'Great-Circle Sailing,' published by Longmans, Green, & Co., Richard A. Proctor advocates the use of the stereographic polar projection for laying out the shortest sea-routes. As is well known, the gnomonic projection is used for finding the great circle between two points that are not too far distant from each other. As this projection, however, does not allow the representation of more than about one-third of the earth's surface, it is not suitable for finding the great circle between points that are far apart. Proctor uses the property of the stereographic projection, that each circle on the sphere is projected into a circle, which may be constructed on the map with great ease. Thus, by laying a circle through two points and one of their antipodes, the shortest route between the two points is found. A similar construction permits the finding of the shortest route which does not cross a certain degree of latitude beyond which navigation would be dangerous. Two maps of the earth are constructed, — one in south polar projection, the other in north polar projection, — and each is adapted to construct routes in one hemisphere.

— Prof. Dr. Paulsen of the University of Berlin, Germany, in a letter in regard to the Berlitz schools of languages, says, "The method of Mr. Berlitz appears to me, as far as I have had the opportunity of familiarizing myself with it by some lessons and the expedients applied, a process specially suited to lead the pupil rapidly, safely, and with comparatively little trouble to himself, —

'*tuto, cito, jucunde*,' in the words of old Comenius, — to the practical mastery of the modern languages. Its peculiarity consists essentially in introducing the foreign tongue as a living tongue, drilling it from the very beginning by ear and speech instead of teaching it by reading and writing, like a deaf-mute language. During the instruction the pupil hears and speaks only the language he is to learn. The effect of this is, first, that he is enabled to follow, without difficulty, even rapid conversation in the foreign tongue; and, second, that he thoroughly acquires the pronunciation as well as the various expressions used in forming an assertion, question, or command. Whether the method can be employed in the instruction of large public-school classes, I am not yet able to state. It appears to me, however, beyond doubt, that the method is specially adapted to advance rapidly adults who desire to study a modern language for practical application. But I am also inclined to believe, that its use, at least supplementary to the ordinary public-school course, is practicable even in large classes, provided the teacher himself can converse in the language to be taught. It would be apt, above all, to re-awaken the pupil's interest, so easily blunted by grammatical exercises and translations. Really the method is only the systematized form of learning a foreign language in a foreign country by its actual use."

LETTERS TO THE EDITOR.

"Take Heed!"

MAY I be allowed to draw attention to an expression that is now creeping into our text-books and journals? Every teacher of chemistry is aware that students, when endeavoring to describe experiments, prefix to almost every sentence the word 'take.' "*Take* a glass cylinder," replies the student, when asked to describe the method by which hydrogen is collected, "fill it with water, and invert it in a vessel filled with water. Then *take* a glass tube and put the end of it under the mouth of the cylinder. Then, when the cylinder is full, *take* a glass plate and put it on the end of the cylinder, and *take* it out of the water," etc.

The careful teacher would interrupt this laborious and involved description at the start by suggesting the more concise statement, "Invert a jar filled with water," etc. Indeed, it is quite remarkable how students, when drilled by good teachers, soon fall into the way of expressing their ideas concisely and accurately; but it is discouraging, in reading articles written by men of high standing, to find directions beginning, "Take a jar," "Take a tube." Time is short, life is short, and our sciences are getting to be endless. Let us therefore discourage all verbosity and inaccuracy, and encourage simplicity and terseness of expression. Let the teacher, when the student begins his ramble by saying, "Well, you take salt, manganese di-oxide, and strong sulphuric acid to which some water has been added," stop him gently but firmly with "I will *not!* I am willing to teach chemistry for a small salary, and to sacrifice myself in the interest of science, but I must draw the line somewhere, and I draw it here. I will *not* take salt, manganese di-oxide, and strong sulphuric acid to which some water has been added."

Let every one be on his guard against the ravages of this word.

PETER T. AUSTEN.

New Brunswick, N.J., Oct. 15.

Ants transplanting the Scale-Bug.

IN bringing in from outside the window the other day some pots of agave infested with scale-bug, I placed one of these near a box of plants. Next day I noticed some red ants engaged at something on the point of one of the leaves. On examining more closely, I found three ants bringing scale-bugs from off a dying leaf of an agave to the leaf of a plant which it barely touched. They incited the slow bugs to move along by touching them with their antennæ, and in the course of half a day they had transplanted several of the half-grown insects. I am pretty sure, from the circumstances, that they were doing this, and I hardly think the scale could have crossed alone, from the position of the leaves. I question if the scale gives up its honey by excitation, like the aphis. I am inclined to believe that they deposit the drops of beautifully clear, viscid honey at night. The ants do associate with the scale for the purpose of gathering this product, and have nests at the base of each plant suffering from scale.

The ants have been in my office for more than four years, and I have come to the conclusion, that, in my fight with the scale, they aid and abet the enemy.

There is one circumstance that reconciles me to the ants: they search out and destroy the larvæ of museum pests. A deer-skin coat infested with moth was thrown on the floor one day, and after a little while I noticed some ants crossing and burrowing in the hair in the most excited manner, and I also noticed some ants carrying away and devouring the plump, white moth-larvæ they had secured. I have seen them carrying the struggling 'millers' also.

WALTER HOUGH.

U. S. National Museum, Oct. 16.

Chest-Development.

I AM glad to say the practical experience of another year has completely confirmed the research I laid before the British Association at Birmingham and Manchester. The best type of chest has been easily obtained in young people; but anthropologists will, no doubt, be surprised to learn that a change in the same direction can with care be made in those of mature age. This I have seen in the diseased chest of a gentleman aged thirty-seven. Between the ages of twenty-five and thirty-three, similar results have been frequently noted. Here are facts that prove the direct power of the surroundings in making the different types of chest we meet with, and consequently we can now avoid those types that are known to be so injurious to the race by substituting for them that which we find at birth. No doubt, the proportion between the height and chest-girth that obtains at birth is a very high one; so much so, in fact, that it has been thought that I was acting unadvisedly in selecting it as the standard we ought to seek to attain. But it exists; and Mr. Brent's maximum chest-girth, obtained from a large number of actual measurements over forty years ago, closely agrees with it.

The method of treatment advocated in the paper on consumption has been successfully applied in six cases. One, whose chest-girth has increased about five inches, and whose vital capacity exceeds Hutchinson's so-called standard of health by seventy cubic inches, has passed medical examination for life-assurance; a second, whose chest-girth has increased nearly three inches, has been examined by a physician, who detected no signs of the previous disease; a third, whose vital capacity was eighty-five cubic inches, and now is two hundred and twenty cubic inches, has borne children, and continues well; and most satisfactory progress has been made in the others. To these we must add Sydenham's cures and the numerous recoveries by nature which were obtained by similar conditions. Hence the practical application of this method has completely confirmed the explanation I gave of the nature of the disease; and I have no doubt whatever that science has gained another victory in the conquest of a great enemy of civilized man.

G. W. HAMBLETON.

Dorchester Place, Blandford Square, London, Oct. 11.

Queries.

37. WHAT NUMBERS DOES IT TAKE TO MAKE A BILLION? — During colonial times, both in England and the Colonies, it took one million of millions to make a billion. During the first half of the present century, I think it may be affirmed that this notation had not been changed, and would have been held binding in law in the United States. It is certainly the most convenient for the astronomer, who has to deal with such enormous distances. The nearest of the twelve or fourteen fixed stars whose distances are approximately known to us require twenty, thirty, or forty English billions of miles to measure the space between the earth and them. The compilers of our modern American arithmetics, without any legislation on the subject, seem to have disregarded the old notation, and to have adopted the French method, of calling in numbers a thousand millions a billion. It is true that the French metric system has been legalized, but it does not make a kilometre an English mile.

E. T. MERRICK.

New Orleans, La., Oct. 13.

Publications received at Editor's Office, Oct. 1-20.

ALDEN'S Manifold Cyclopedia of Knowledge and Language. Vol. VIII. Ceylon to Club-foot. New York, J. B. Alden. 12°. 50 cents.
—— Same. Vol. IX. Club-rush to Cosmogony. New York, J. B. Alden. 12°. 50 cents.
ATKINSON, P. The Elements of Electric Lighting. New York, Van Nostrand. 260 p. 12°.
BRANDT, H. C. G. A First Book in German. Boston, Allyn & Bacon. 373 p. 12°. $1.
CANNAN, E. Elementary Political Economy. London, Henry Frowde. 150 p. 16°. (New York, Macmillan. 25 cents.)
CAREY, Rosa N. Aunt Diana. Philadelphia, Lippincott. 208 p. 16°. $1.25.
CHAMBERS'S ENCYCLOPÆDIA. New ed. Vol. II. Beaugency to Cataract. Philadelphia, Lippincott. 828 p. 8°.
CHARDENAL, C A. First French Course or Rules and Exercises for Beginners. New ed. Boston, Allyn & Bacon. 257 p 16°.
CLUM, F. D. Inebriety: its Causes, its Results, its Remedy. Philadelphia, Lippincott. 248 p. 12°. $1.25.
DAWSON, J. W. Specimens of Eozoon Canadense and their Geological and other Relations. Montreal, Dawson Bros. 106 p. 12°. 50 cents.
DEWEY, J. Leibniz's New Essays concerning the Human Understanding. A Critical Exposition. Chicago, S. C. Griggs & Co. 272 p. 16°. $1.25.
DEWEY, Julia M. How to teach Manners in the School-room. (The Reading Circle Library, No. 7.) New York and Chicago, E. L. Kellogg & Co. 104 p. 16°.
DUNN, J. P., Jr. Indiana. A Redemption from Slavery. Ed. by H. E. Scudder. Boston and New York, Houghton, Mifflin, & Co. 453 p. 16°. $1.25.
EARLE, J. A Hand-Book to the Land-Charters, and other Saxonic Documents. Oxford, Clarendon Pr. 519 p. 12°. (New York, Macmillan.)
FIRTH, C. H., *ed.* Johnson's Life of Milton. Oxford, Clarendon Pr. 144 p. 16°. (New York, Macmillan, 40 cents.)
FOOTE, Mary Hallock. John Bodewin's Testimony. 5th ed. Boston, Ticknor. 344 p. 16°. 50 cents.
FOSTER, S. C. Massa's in the Cold, Cold Ground. Boston, Ticknor. 12°. $1.50.
FOWLER, W. W. Tales of the Birds. London and New York, Macmillan. 209 p. 12°. $2.50.
GERARD, E. The Land beyond the Forest: Facts, Figures, and Fancies from Transylvania. New York, Harper. 403 p. 12°.
GIBBONS, J. Tenure and Toil; or, Rights and Wrongs of Property and Labor. Philadelphia, Lippincott. 316 p. 12°. $1.50.
GOODE, G. B. The Fisheries and Fishery Industries of the United States. Section I. Natural History of Useful Aquatic Animals. Washington, Government. 895 p. 4°.
HART, V. C. Western China: A Journey to the Great Buddhist Centre of Mount Omei. Boston, Ticknor. 306 p. 12°. $2.
HILL, G. B., *ed.* Goldsmith. The Traveller. Oxford, Clarendon Pr. 53 p. 16°. (New York, Macmillan, 25 cents.)
HIROI, I. Plate-Girder Construction. New York, Van Nostrand. 94 p. 24°. 50 cents.
HOFFMANN, H. Froebel's Kindergarten Gifts. (Teachers Manuals, No. 10) New York and Chicago, E. L. Kellogg & Co. 32 p. 16°.
HUGHES, J. L. How to keep Order. (Teachers Manuals, No. 8.) New York and Chicago, E. L. Kellogg & Co. 46 p. 16°.
HUNTINGTON, F. D. Unconscious Tuition. (Teachers Manuals, No. 7.) New York and Chicago, E. L. Kellogg & Co. 42 p. 16°.
JERRAM, C. S., *ed.* The Second Book of Xenophon's Anabasis. Oxford, Clarendon Pr. 69 p. 16°. (New York, Macmillan, 40 cents.)
JUKES-BROWNE, A. J. The Building of the British Isles: A Study in Geographical Evolution. New York, Scribner & Welford. 343 p. 12°.
LINDSLEY, D. P. The Shorthand Exercise Book. Part I. Chicago, D. Kimball. 34 p. 12°. 25 cents.
——Key to the Shorthand Exercise Book, Part I. Chicago, D. Kimball. 31 p. 12°. 35 cents.
——The Manual of Fonetic Analysis. Chicago, D. Kimball. 31 p. 16°.
LOGAN, A. S. Jesus in Modern Life. Philadelphia, Lippincott. 299 p. 12°. $1.25.
MICHIGAN State Board of Health, Fifteenth Annual Report of the Secretary of the, for the Fiscal Year ending June 30, 1887. Lansing, State. 232 p. 8°.
MOBERLY, C. E., *ed.* The Commentaries of C. Julius Cæsar. The Gallic War, Books I. and II. Oxford, Clarendon Pr. 105 p. 16°. (New York, Macmillan. 50 cents.)
NALL, G. H., *ed.* Stories from Aulus Gellius, being Selections and Adaptations from the Noctes Atticæ. London and New York, Macmillan. 153 p. 24°. 40 cents.

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SCIENCE

FRIDAY, NOVEMBER 2, 1888.

THE *Independent* for Oct. 25 has an interesting article by President Gilman on 'The Future of the Johns Hopkins University.' It is the settled purpose of that institution, for the future as in the past, to maintain a collegiate or undergraduate course of study, and also a system of university or post-graduate courses. The college students come mostly from Maryland. The post-graduate students are from all parts of the country, but President Gilman thinks that in the future they will come more and more largely from the South. The university is now in most departments very well organized, but two professorships of great importance — philosophy and English — are still unfilled. Professor Hall, who was to have been the head of the philosophical department, has been called to the presidency of another institution, and his place has not yet been supplied. The search for a professor of English literature, too, has not yet been successful; for the authorities of the university want a man like Matthew Arnold or James Russell Lowell, and such men are not easy to get. Strenuous efforts are making, however, to fill both these positions, and every one will hope that the right men may be found. Mr. Hopkins, as is well known, left a large sum to found a hospital, with the intention that the university should establish a medical school in connection therewith. The hospital buildings are now completed, and the university has already established three professorships as the beginning of a medical department. "The only cause for anxiety in the future of the Johns Hopkins University," says President Gilman, "is the suspension of dividends by the Baltimore and Ohio Railroad. The founder gave the university fifteen thousand shares of the common stock of the railroad, and he recommended the trustees in the most explicit terms to keep, protect, and defend this investment." The income from this stock has been about $150,000 a year, and has been the main support of the university; and, now that it has ceased for a time, there is little to sustain the institution except the tuition-fees and the moderate surplus that has been accumulated in past years. President Gilman suggests that the friends of the university should make up an emergency fund to relieve its present needs, and expresses confidence that such an institution as the Johns Hopkins University "will not long be allowed to suffer for the want of an income." This confidence we believe to be justified; and certainly every lover of learning will hope that a university of so much promise may suffer no check in its useful career.

THE THOROUGHNESS with which statistics are collected under the direction of Col. Carroll D. Wright by the Labor Bureau at Washington is well illustrated in the gathering of the facts in regard to marriage and divorce in the United States, that are to be embodied in a special report that will be ready early in January. The special agents engaged in this work have obtained the figures from every court in the country having divorce jurisdiction. When it is stated that there are more than twenty-seven hundred of these courts, and that the period of investigation extends over the ten years from 1876 to 1886, the magnitude of the work may be imagined. The report in each case will give the ages of the persons divorced, the cause for which the separation was granted, state whether the husband or wife obtained the decree, the number of children, the place of marriage, and the migration of the couple since then. This latter inquiry is made in order to show whether the change of residence was *bona fide*, or merely for the purpose of obtaining a divorce. Statistics showing the length of time the marriage lasted, and other facts that may tend to throw light on the subject, have also been collected. The number of marriages will be given by counties for the same period, so that the ratio of divorces to marriages may be seen. There will be added a synopsis of the divorce laws of every State, and the statistics of divorces in the principal countries of Europe. No such investigation for original information has ever been made in any country, and there is none in which it could be made. If it were possible for such a force of experts to be organized elsewhere as Colonel Wright commands the services of to make the inquiries, prejudice, red tape, and respect for established institutions, would prevent them from obtaining the information they sought. Americans have reason to feel proud when they remember that nowhere upon the globe is there an organization, public or private, so well equipped for the collection of social statistics as the United States Labor Bureau.

AT LENGTH THERE IS PROSPECT of the speedy erection of a building for the Congressional Library,— for this we suppose we all ought to be truly thankful, in view of the narrow-minded way in which Congress treated the subject at the late session,— but we fear that the edifice will not be one upon which we shall have occasion to waste much pride. This is no reflection upon General Casey, who is hereafter to have full charge of the work, for we believe that he will make the best building possible with the funds at his disposal. The foundations of the building have already been built in accordance with a plan that contemplated a structure ultimately to cost ten or twelve million dollars. The cost of this work and of the necessary excavations has been several hundred thousand dollars, probably more than half a million. Economy requires the utilization of this work, and General Casey has therefore wisely concluded that the plan of the building he will erect shall be substantially the same as that before contemplated, but that he will so manage it by saving upon the cost of material, on ornamentation, etc., as to keep his expenditures within the four million which Congress has appropriated, and to which it has absolutely limited the cost. It is rare that a public building does not cost from twenty-five to fifty per cent *more* than is estimated: to erect a building for seventy-five per cent *less* than the estimated cost will be a task that no one will envy General Casey. And yet there will be a building of some sort completed much sooner than there has been any reason to anticipate. It will afford accommodation to the books and other literary and art treasures now in the Congressional Library, and for those that will accumulate for a few years to come. By the time it is full, there may be in Washington some Congress that can appreciate the value of a great library, and that will be broad-minded and patriotic enough to provide a building suitable for its accommodation, and of such style of architecture that it will not cause an American citizen to blush when he contemplates it.

CENTENARIANS IN FRANCE.[1]

M. LEVASSEUR has recently published the result of an inquiry into the number and condition of those who had reached the age of one hundred years, which gives interesting information regarding the extreme limits of human existence, and the proportion of men that attain it. The newspaper account of centenarians frequently ascribing an age of anywhere from one hundred and ten to one hundred and thirty years, and emphasizing details showing remarkable preservation of faculty, is of course utterly unreliable. A slight investigation is often sufficient to show the groundlessness of such pretensions. In 1871, of 37 reported centenarians in Bavaria,

[1] See an article by M. V. Turquan, *Revue Scientifique*, Sept. 1, 1888.

not one was found really one hundred years old. In Canada the census at the same time showed 421 centenarians. Of these, only 82 could prove their citizenship, and of these only 9 were really one hundred years old, while it was probable that a still smaller proportion of the others were genuine centenarians. The 1886 census of France records 184 centenarians,— 66 men and 118 women. This number, though not in excess of the usual record, has aroused suspicion, and led to further inquiry.

The reasons for falsification are quite evident. A peculiar and innocent kind of pride; ignorance of their real age; the assurance of being very, very old, — all these, in passing from mouth to mouth, become cases of advanced centenarianism. Upon closer inquiry, of these 184, only 83 stood the slightest investigation; of the remaining 101, many were really very old, but not one hundred years old; and three young persons gave in their answers as a joke. A reference to the birth register showed that 49 of the alleged centenarians were really of the following ages: 1 of 77, 2 of 78, 1 of 79, 1 of 80, 1 of 82, 1 of 86, 1 of 89, 4 of 90, 4 of 91, 6 of 92, 1 of 93, 4 of 94, 6 of 95, 5 of 96, 2 of 97, 2 of 98, and 7 of 99. Of the rest, no reliable information was obtainable.

Of the 83, only 16 showed their baptismal records to the authorities at Paris; the other 67 did not send their records of baptism to Paris (in some cases these were seen at their houses), but produced the less satisfactory evidence of a marriage certificate, etc. Of these 83 (containing an uncertain number of fraudulent cases, no doubt), 31 were men and 52 women. Of the men, 6 had never married, 2 were married, and 23 widowers: corresponding numbers for the women were 10, 1, and 41. Again: 44 were just 100 years old, 16 were 101, 7 were 102, 6 were 103, 5 were 104, 3 were 105, and 1 claimed to be 112 and another 116 years old, yielding an average age of 101 years and 4 months. The veteran of 116 years is reported to be in good health in June last at 118 years. But dismissing this as well as the preceding case, 105 may be regarded as the extreme limit of life in France.[1]

The profession of 59 of the 83 was ascertainable: 22 were farmers and laborers, 9 were handicraftsmen, 8 were land-holders, 6 were cooks or domestics, 5 were merchants, 2 were shepherds, and of the other 7, 1 was a teacher, 1 an insurance-agent, 1 a hotel-keeper, 1 a midwife, 1 a widow of a costumer, 1 a widow of a doctor, and 1 a widow of a stone-cutter. They can also be classified as follows: those living in actual poverty, 22; of very limited means, 10; of a modest fortune, 7; in easy circumstances, 6; wealthy, 1; present fortune unknown, but quite limited in means (as can be deduced from their former professions), 37. The fact that so large a proportion of centenarians come from the poorer and the hard-working classes is a striking one, and is borne out by the statistics of other countries. Their habits of life, too, when such information is obtainable, point to a simple, wholesome diet, much outdoor activity, and little care.

Another means of gauging the number of centenarians is by the number of annual deaths of persons of 100 years or more. In the twenty years from 1866 to 1886 the deaths of 1,474 such persons are reported (553 men and 921 women), or about 73 such deaths annually (27 men, 46 women). This justifies the conclusion that about 70 centenarians for France is a liberal if not a maximum estimate, and the every-day reports are greatly exaggerated. The average annual death-rate of centenarians for the years 1855 to 1885 is 87, or 1 to about 15,000 of the population, — a doubtlessly greatly exaggerated account.

A topic of interest to French but hardly to American readers, is the local distribution of the centenarians in the different departments of France. The southern portion, and especially the region bordering upon the Pyrenees, is particularly fruitful of centenarians.

While these statistics serve to correct popular estimates, they are themselves not rigid enough to be accepted as they stand. Many suspicious points still occur: the preponderance of women over men is too great to be capable of a biological explanation; the preponderance of the working-classes may be a sign of ignorance or of mendacity as well as of longevity; and so on. At any rate, the general conclusion seems warranted that there are really very few centenarians to a million souls.

[1] One of these patriarchs stands at the head of five generations, and counts ninety-five children and grandchildren; another has seventy direct descendants.

THE TOPOGRAPHIC MAP OF NEW JERSEY.

MENTION has been made in *Science* from time to time of the topographic maps of different parts of the country, and in particular of the numerous sheets that constitute the 'Atlas of New Jersey.' The seventeen sheets, on a scale of a mile to an inch, and with contours every ten or twenty feet, covering the whole State, have all been issued, and are now followed by two general maps of the State on a scale of five miles to an inch. The first of these gives counties, townships, cities, villages, railroads, and many of the roads, but gives no indication of the topographic relief. The second has the railroads and a small number of towns, and indicates the topography with great nicety by a series of tints of increasing darkness with increasing height. Thus for the first time in this country is the form of one of our States duly portrayed.

The map is a picture that the geographer may lean over for hours with increasing interest. The features of the State are brought out with perfect distinctness. The broad plains of the southern half, where the railroads run along the flat divides between the streams, is shown in the strongest contrast with the rugged highlands of the northern half, where the valleys alone afford highways. The curiously curved ridges formed by the trap sheets of the triassic area appear with their well-marked individuality. The faintly submerged valleys of all the salt-water coast-line are distinctly revealed by the estuary-like form of the lower stream-courses; and all this not merely in outline, as it appears on ordinary maps, but with accurately determined contours, giving the quantity as well as the quality of the form of the State. Besides this, the map is very suggestive in the way of displaying hitherto unsuspected problems, whose very quantities were unknown before. Now they take definite shape, and call for solution. Look, for example, in the southern half of the State, at the general line of divides between the streams flowing into the Atlantic and those flowing into the Delaware, and note not only the great bend, but also the diminution in height of the line at the head of the Rancocas: has this not some connection with the bend of the Delaware from its direct course at Bordentown? See the oblique truncation of Sourland Mountain on a line, that, when extended, leads to the similarly oblique truncation of the Watchung Ridges: is there not some great dislocation responsible for this coincidence? Notice the heavy morainic barrier that bisects the Passaic basin within the Watchung Ridges: the present line of escape for the Passaic from the Great Swamp that lies outside of the moraine must have been adopted since the glacial period. It is only when the relief of the ground is given quantitively, as by contours, that problems such as these can be discussed satisfactorily: hence the great advance that geography may count upon when accurate contoured and shaded maps are published for other States.

This map of New Jersey recalls a similar one of Scotland, prepared by Bartholomew, with explanatory text by James Geikie, and published in the first number of the *Scottish Geographical Magazine* a few years ago. Professor Geikie did good service to geography in calling attention to the absolute need of good maps, showing the real form of the country that one has to study; and we would gladly repeat and emphasize every word that he says as to their educational value. But there is another curious correspondence between the two cases: Geikie's physical description of the Scottish highlands and lowlands applies with extraordinary accuracy to the northern third of New Jersey. In both, the highlands are distorted and ancient hard rocks, which have been heavily eroded, and whose general upland surface is an old lowland, elevated, and now deeply consumed by valley-making streams. Both highlands are separated from the lowlands that lie south-east of them by a great fracture, with up and down throw on corresponding sides. Both lowlands owe their present moderate elevation not so much to any depression that they have suffered as to the broad wasting-away of their relatively soft rocks; while the hard crystallines of the highlands have wasted more slowly, and still retain much of the height that the lowlands have lost. The ridges that rise above the lowlands, both in Scotland and New Jersey, are beds of volcanic rock that have, like the highlands, wasted slowly, so as to stand up in strong relief above the softer rocks on either side. There are, of course, differences in plenty

between the two regions, but the correspondences are certainly extraordinary.

We shall hope soon to hear that the excellent and practical work of the New Jersey Survey has been appreciated by the school-boards of that State, and that copies of this new topographic map and of the appropriate local sheet of the State atlas have been placed in all the high schools and academies. Teachers could then carry on the modern reform in geographic teaching beyond its simple first step, which involves a map of the school-yard and home town, to the more difficult second step, in which correct maps of larger areas are needed. Until this is generally possible and actual, reform in geographic teaching will not go far beyond the merest elements of the subject. If Professor Cook is as successful in putting the State maps into practical use as he has been in surpervising their preparation, we shall owe him a double debt.

W. M. D.

TISSOT'S THEORY OF THE PROJECTION OF MAPS.

THE question as to what projection to select for a certain map is one of great importance to the cartographer. As is well known, the earth's surface cannot be represented on a plane sheet of paper without distorting the lengths of lines, and without altering the size of surface or of angles; and for this reason it becomes the duty of the cartographer to select a projection, or a method of representing the curved surface on a plane, by which the distortions and alterations become as small as possible. Merit is due a French geographer and mathematician, M. A. Tissot, for having first pointed out a method by which this problem can be easily solved. Unfortunately his book, which was published in 1881,[1] is little known, and therefore the necessary process of replacing the old projections, which he has proved to be inadequate, by new and better ones, is making hardly any progress.

The principle which underlies his researches is so clear and simple, that it may be stated here. Tissot assumes an infinitely small circle on a curved surface. If this surface is represented on a plane, the circle assumes the shape of an ellipse, on account of the unavoidable distortion. The great and small diameters of this ellipse are a and b, and their ratio is a measure of the angular distortion, while their product is a measure of the alteration of surface. The ratio between a and the radius of the original small circle, r, is a measure of the alteration of scale. Tissot shows how to compute the length of the axes of this ellipse, which he calls the indicatrix, as indicating the distortion, and how to determine their direction.

This general theory is next applied to the construction of maps. For any law according to which a system of meridians and parallels is constructed, we can compute a and b as functions of latitude and longitude, and thus a means is obtained of studying the distortions all over the surface of the map.

Maps are made to serve various purposes. In many cases it is necessary that a square inch on one part of the map should represent the same area as a square inch on any other part of the map, or, as it is generally expressed, that the areas should be preserved. Projections of this kind are called 'equivalent,' while Tissot introduces the expression 'authallic.' It is evident that every projection in which the indicatrix-ellipse is equal to the small circle, is equivalent. In other cases it is desirable that each small part of a map be similar to the corresponding part of the earth. This is possible only when the indicatrix is a circle; that is, when $a = b$. These projections are called by Tissot 'autogonal,' as the angles are preserved. In still other cases we do not mind an alteration of angle and surface, but wish to preserve the length of lines as much as possible. For this purpose the ratio of a, b, and r must be as near 1 as possible. Tissot calls projections in which angles and surfaces are altered 'aphylactic.'

The problem, according to this, is very simple. According to the purpose for which a map is intended, we choose one of the three classes of projections. It is the task of the cartographer to select the projection for a map so that, if one property is preserved, the others are changed as little as possible. If, for instance, the areas are preserved, the angles must be altered as little as possible. A projection which has this property is called by Tissot 'perigonal,' while an autogonal projection in which the alteration of surface is a minimum is called 'perihallic.' We have seen that the distortion is a function of latitude and longitude. If, then, a country of limited extent is given, we must study this function over the whole area of the map; and, as there are an infinite number of each class of projections, we are able to select the function so that the unavoidable distortion of one of the elements becomes a minimum.

The last case, that of 'aphylactic' projections, has been treated by Airy in his projection by balance of errors; but the theory of these projections and their application to certain areas has first been given by Tissot. His admirable work must form the basis of all future cartographic work.

The importance of his researches may be understood by his discussion of the distortions of the map of France. The great map of the war department of that country is constructed in Bonne's projection; the map being equivalent, and the maximum alteration of angle being 18 minutes, and the greatest distortion of scale $\frac{1}{850}$. These would have been 10′ 30″ and $\frac{1}{860}$ respectively, if a more suitable central meridian had been selected; but they would have been reduced to 25 seconds and $\frac{1}{110}$, if Tissot's principles had been applied.

It is to be hoped that the thorough study of his work will lead to the adoption of better projections than those which are at present in use.

[1] *Mémoire sur la Représentation des Surfaces et les Projections des Cartes Géographiques.* Par M. A. TISSOT. Paris, Gauthier-Villars.

SCHOOL-WORK AND EYESIGHT.

Five Per Cent of Near-sighted Children in an Old, Badly Illuminated and Ventilated School-Building, and only 2.8 in a New, Well-arranged Building. — School Life, according to Dr. Tiffany of Kansas City, has Little or Nothing to do in the Development of Ocular Anomalies.

IN the chapter entitled 'Our School Systems,' which is one of the most interesting and suggestive of all those that will accompany the forthcoming annual report of the United States commissioner of education, the effect of school-work on eyesight will be very fully discussed, chiefly in extracts from the reports of city school superintendents.

Mr. George Howland, superintendent of Chicago schools, says: —

"In the old school-rooms, and we need not go far back for them, the light was often so insufficient, that much harm undoubtedly resulted to the eyes of the children. But in our newer buildings so much thoughtful attention has been given to this subject, that the evil no longer exists there. Pupils, too, have been allowed to study with too little regard to position, and with the object too near the eye; perhaps with the result of myopia in some cases, but by no means, in my judgment, to the extent often charged.

"The oculist is too definite, and too certain in his knowledge. Why should the book or paper always be 'fifteen inches from the eye'? Five feet seven may be the average height of a man, and eight the right number for his boot; but is he to be considered deformed, or a monstrosity, who is five feet six, or who wears a number seven or nine?

"Of over eighty thousand children in our schools, I have never seen one voluntarily take that distance, and have eminent professional opinion that such an enforced rule would work more harm than ever our neglect has done. Nothing will lie so unblushingly as figures."

The following, from the report of the board of education, describes the results of a recent examination of the eyes of the pupils of two of the leading public schools of Memphis, Tenn: —

"The eyes of 681 pupils have been examined. Of these, 588 had perfect sight, 60 had imperfect sight from general causes, and 30 had impaired vision from eye-strain. It is interesting to trace the gradual increase of this form of impaired sight (near-sightedness) from the primary classes, where it is hardly noticeable, to the highest grade, where it reaches fifteen per cent. In this particular my results are similar to those obtained by examiners in this and other countries. But a point which should not be overlooked is this, — that my examinations were confined to pupils in two different school-buildings, each of which may be taken as a sample of its class. The Market Street building has been recently constructed,

and is well arranged, both as to illumination and ventilation; whereas the antiquated structure on Linden Street is sadly deficient in both of these particulars. Now compare the percentage of near-sighted children in corresponding classes (fourth, fifth, and sixth) in the two buildings, and you will find that while the Market Street school has 2.8 per cent, the Linden Street school has 5 per cent. These figures commend the new building as strongly as they condemn the old, and no stronger plea can be advanced for new buildings, so constructed as to furnish proper illumination and a plentiful supply of fresh air, than is furnished by these figures, which show that nearly double the number of the pupils with impaired sight come from a badly constructed building with poor light and bad air."

In November, 1886, Dr. H. P. Allen of Columbus, O., was appointed by the board of education of that city to examine the eyes of the pupils of the public schools. In his report he says: —

"I examined between Dec. 12, 1886, and June 6, 1887, the eyes of 4,700 pupils of the public schools, as follows: All of the high-school classes, 12 in number; all of the grammar schools, 72 in number; all of the primary schools, 24 in number; and 12 of the B, C, and D primary schools; making a total of 120 schools out of the 200 of the city. This included all of the children above 10 years of age, with the exception of about 250, who were scattered through the various lower schools. I visited all of the school-buildings, and saw most of the school-rooms.

"The examinations were made chiefly to determine the condition of vision of the children, and find, in cases where vision was defective, the correcting glasses. The work was done in the school-room during school-hours. Each child was examined separately, its name, age, sex, nationality, complexion, color of eyes, condition of sight, and required glass noted at the time. My records indicate the kind of trouble and the condition of sight with sufficient accuracy for all practical purposes, and enable us to draw certain well-defined deductions. The points to which I wish especially to call your attention are as follows: —

"First, The large number and percentage of pupils among the 4,700 with one or two defective eyes, — 1,175 cases, or 25 per cent of all the children examined.

"Second, Those with two defective eyes, — 936, or 20 per cent of all the children examined.

"Third, The increase in prevalence of near-sightedness as we go up the scale from 0 per cent in the D primary schools to 13 per cent in the senior class of the high school, and 17 per cent among the females of the senior class from 0 per cent at the age of 6 years to 11.3 per cent at the age of 17 years, showing the relation of this trouble to increasing age and increasing demands upon the eyes.

"Fourth, The about equal percentage of each of the other defects in the low, intermediate, and high grades, showing their independence of increasing years and increasing demands upon the eyes.

"Fifth, the diminution in the percentage of good eyes as we ascend the scale, from 80 per cent in the D primary to 66.6 per cent in the senior class of the high school."

A similar examination was made during the year, of the eyes of pupils in the public schools of Kansas City and Nevada, Mo., and of the students of the State normal schools at Warrensburg and Kirksville, Mo., and the State universities of Missouri and Kansas, by Flavel B. Tiffany, M.D., of Kansas City, Mo. The results of this examination differ in at least one material respect from those reported from Memphis and Columbus. The most important facts developed, with other matters of interest mentioned by the examiner, are here shown: —

"That perfect vision, perfect eyesight, be enjoyed by our progeny, depends largely upon the recognition of any defect, slight though it may be, in early life, timely correction of the same if possible, and care and proper use of the organ while in the school-room. That many a boy or girl with some anomaly of refraction or accommodation has been allowed to suffer day after day in order to keep pace with his class, and eventually develop more serious conditions or even blindness, is too evident; whereas if the trouble had been recognized in time, and proper steps taken, much suffering as well as serious consequences could have been averted. The object of these investigations is to ascertain the condition of the eyes of the youth, the effect of use of the organ for near and small objects, and the final consequences; and finally, if possible, to correct the evils arising before irremediable damage has been done.

"In our investigations not only myopia but hypermetropia, astigmatism, spasm of accommodation, and strabismus were looked for. Every eye that was not up to the standard of vision (that of twenty-twentieths) was not dubbed myopic. A careful examination was made with the trial glasses, or optometer, and a more accurate diagnosis made. Our results show a much larger per cent of hypermetropia and astigmatism, and spasm of accommodation, than myopia, there being nearly four times as many hypermetropic pupils as myopic. Of the whole number examined, 2,040, in the different grades and schools, 99, or 4.8 per cent, had spasm of accommodation. Now, spasm of accommodation, or simple hypermetropia even, if not corrected by glasses or relieved by rest from near and small objects, is likely to develop into myopia, or possibly intra-ocular disease: hence the importance of these examinations.

"In our examinations the increase of anomaly of refraction as we ascend in the grades is not marked, — in fact, in some schools it seems to diminish, — but this would not be a definite proof one way or the other, since from one examination, as a different set of pupils are examined in each grade and in each school, there is no means of knowing but that those of the higher grades started with the same degree of anomaly in the primary departments as is found in the seventh year of the grammar school or the high school. In fact, it seems to be true that pupils with anomalies of refraction, both myopes and hypermetropes, are closer students and fonder of books and study than the emmetropes or those of perfect vision; and hence these students remain in school, while many of those with perfect vision drop out before they reach the higher departments. In our examinations we find a greater percentage of anomaly among the normal schools of Kirksville and Warrensburg than any other; but it does not necessarily follow that this is the result of a longer course of study and closer application with the eyes, although it is conjecturally true. The only way to prove that study is the cause, or otherwise, is to watch the same set of pupils from the primary department up through the different grades, and see if John, Mary, and James, starting at six or seven years of age in the primary department with perfect emmetropic eyes, finally later on develop myopia. In our examinations this can be done, as we have the name in full, color of each eye, present amount of vision, whether there is any hereditary defect or not; and now, should the examinations be continued and the same pupils called for as they enter the higher grades year after year, a very definite and satisfactory idea can be gained.

"As to the lighting and ventilation of our school-rooms, very little need be said, as so much attention has been given to this subject by our efficient board, that the Kansas City school-room is almost perfection in those particulars. In the Washington School, where we find the largest per cent of defective eyes in the lower grades, I noticed first and second year pupils, for want of room, were crowded into a room calculated for older pupils, and hence the distance between the desk and the seat was too great, as well as that from the seat to the floor, compelling the little pupil to hang, as it were, upon the desk, his feet not touching the floor. This position, of necessity, brought his face too near his book or slate, and hence taxed the power of accommodation of the eyes to a great degree; and besides, this school, from its location on the north side of the hill, is not so well lighted and ventilated as others. In the Nevada School I found a less degree of anomaly among the same grade of students than in the Kansas City schools. This I attributed to the fact that the school is in a small country town, where the children have more freedom of the field, where they are not crowded so much as our city children are, and perhaps have better ventilated school-rooms.

"There were 2,040 pupils examined, embracing seven different nationalities, besides several of mixed nationality.

"Of the 1,422 Americans, 300, or 21.1 per cent, have some anomaly of refraction.

"Of the 129 Germans, 32, or 24.8 per cent, are affected; of the 26 French, 5, or 19.2 per cent; of the 15 Scotch, 3, or 20 per cent; of the 67 Irish, 20, or 27.8 per cent; of the 47 English, 8, or 17 per cent; of the 11 Swedish, 3, or 27.2 per cent; of the 93 mixed, 22, or 23.6 per cent.

"The Irish, Swedish, and Germans have the highest percentage of affections; the English, French, Scotch, and Americans, the lowest percentage. Out of the whole number examined, 1,162 were girls and 878 boys; 458 had some ametropia (some anomaly of refraction). Of the 1,162 girls, 290, or 24.9 per cent, were ametropic; of the 878 boys, 168, or 19.1 per cent, were ametropic; being a larger per cent of affection among the girls than among the boys.

"Out of the 2,040 pupils, 13, or 0.6 per cent, had strabismus; 94, or 4.6 per cent, were myopic; 202, or 9.9 per cent, were hypermetropic; 42, or 2.06 per cent, were astigmatic; 99, or 4.8 per cent, had spasm of accommodation; and 63, or 3.1 per cent, had latent hypermetropia.

"We find that hypermetropia predominates. If we add latent hypermetropia and spasm of accommodation, saying nothing of astigmatism, of which the majority was hypermetropic, we have 364 hypermetropes to 94 myopes, or nearly four times as many hypermetropes as myopes, or over twice as many as all the other affections taken together. In the table, as seen, all the grades, from the primary through the grammar school, high school, normal school, and university, are represented; but in no instance, excepting the Kansas State University, is there any thing like a gradual increase of myopia or any of the anomalies simply or collectively. In nearly all of the schools there seems to be a higher per cent of affection in the first years; then, a little later in the course, a marked diminution; and then again an increase. Probably many of those having some trouble after remaining in school for a short time drop out, which would account for the diminution; and then spasm of accommodation and latent hypermetropia becoming manifest later on, or perhaps developing into myopia, would account for the increase in this affection.

"School-life, however, as stated above, so far as I can gather by these examinations, has little or nothing to do in the development of these anomalies. That they exist, however, in a much greater degree than is generally supposed, is very evident; and that continuous use of the eyes having these errors of refraction, whether in the school-room or out of it, if not corrected, is sure to have its evil consequences. The importance of a recognition of the existence of these anomalies, of their extreme frequency, and of detecting and correcting them, is obvious enough. We should take into consideration that spasm of accommodation and latent hypermetropia frequently exist, and that these affections often develop into myopia; and if recognized early, and timely treated by rest and glasses, much suffering and irremediable troubles are averted. Cohn and others may have been able, twenty years ago, to trace the development of myopia to badly appointed school-rooms; but here in America our school-rooms are so carefully arranged as to light, seats, desks, ventilation, etc., that we can scarcely attribute to the work in the school-room the cause of anomalies. In a very great degree these errors of refraction are congenital, frequently they are latent, and, if the eyes were not overtaxed by near work, they would never become manifest. The evil arising from work in the school-room is that these errors of refraction are not perceived, and hence not corrected. If the teacher could be made to understand that the little pupils complaining of headache, pain through the temples, and weakness of the eyes, or dimness of vision, arose neither from stupidity nor desire to avoid study, but that these complaints were symptoms of some defect of the organ of vision, or, what would be better still, let a competent oculist carefully examine each child as he enters upon each year of study in the school-work, and his anomaly, if he have any, corrected, anomalies would gradually diminish."

COMMERCIAL GEOGRAPHY.

The Neglect of Native Fruit-Plants in California.

SINCE the settlement of California, its fruit-growing interests have rapidly gained great importance. It is remarkable, that, notwithstanding the economic value of this industry, hardly any attempts have been made to utilize the native fruit-plants; and Mr. H. Semler, who is so well conversant with the flora of California, has done good service in calling attention to the numerous plants that appear well worth being cultivated, and promise to become a source of considerable revenue. He states, that except the seeds of the nut-pine, which are sometimes used as a dessert, only one or two species of blueberry (*Vaccinium*) are sold, although they are not cultivated. Hardly any attempts have been made to cultivate the numerous native berries. In a recent number of *Petermann's Mitteilungen* he draws attention to a number of these plants.

There is a good Californian raspberry (*Rubus leucodermis*). The European raspberry is cultivated with limited success only in the valley of the Hudson and in New Jersey, although its culture is made difficult by the extreme cold of winter. For this reason attempts were made to cultivate *Rubus strigosus* and *Rubus Occidentalis* (the red raspberry and the thimble-berry). By breeding and crossing these species, the raspberries now in use were obtained. These have been introduced into California, while the native raspberry of that State is neglected, although, even in its wild state, it has a better taste than the wild eastern berries.

In the same way the eastern blackberries and dewberries have been introduced, although two excellent species are native to the Pacific coast. Since the discovery of the 'Lawton' or 'New Rochelle,' numerous varieties of *Rubus villosus* have been cultivated, and plantations of great extent and value are found in California. No attempts, however, have been made at developing *Rubus ursinus*, a native of the Californian coast, which is used by farmers for making jams and jellies; nor has *Rubus pedatus* of the Sierra Nevada, which has small and sweet jet-black berries, attracted any attention.

Gooseberry-culture has so far been a failure in North America. The European varieties degenerate and perish after a few years. A few years since, *Ribes aureum*, a native of Missouri, was cultivated and used as a stock for the European great-fruited varieties. The Californian *Ribes divaricatum* seems still better adapted to this purpose, and with proper culture it will undoubtedly produce fruits that will equal the European varieties in every respect.

The salmon-berry (*Rubus spectabilis*) and the Pacific thimble-berry (*Rubus Nutkanus*) are admirably adapted for making jams. Both have a peculiarly sweet and aromatic taste and very small seeds. They do not keep any length of time, and cannot be transported on account of their softness, but may be preserved, as is now extensively done by settlers in the woods of Oregon and British Columbia. The young sprouts of the salmon-berry are boiled, and are said to be better than spinach.

Besides these, we mention the large currant, *Ribes bracteosum*, which would probably prove a valuable shrub; the *Leña amarilla*, one of the four Californian barberries, which is frequently used in Mexico, but has not attracted the attention of horticulturists; and the Californian vine, *Vitis Californica*, which might be developed just as well as the eastern species of *Vitis æstivalis* and *V. riparia*, which have become the stock of renowned eastern vines.

It would be well if Californian horticulturists would not only direct their attention to foreign products and to endeavors to introduce them into California, but also attempt to cultivate the native plants of their State, many of which might become sources of important industries.

ELECTRICAL SCIENCE.

Improvements in Methods of Manufacturing Storage-Batteries.

MR. MADDEN, in the *Electrical World*, describes some recent improvements in the methods of manufacturing secondary batteries of the grid type. The plates of which these batteries are composed have been made heretofore by pasting by hand a mixture of red lead and sulphuric acid into hourglass-shaped holes in a cast-lead frame. Hand-labor in such work has two objections: it is expensive, and it does not give uniform results. The life of the cell, and its freedom from expensive depreciation, depend to a great extent on a perfect uniformity of condition all over the plate. To attain this, Mr. Madden has devised a machine that pastes the plate automatically, giving a uniform density to the red lead in each hole.

The red lead, mixed with the proper amount of dilute sulphuric acid, is fed to a mixing-screw of varying pitch, working in a cylindrical casing. The pitch of the screw is such that the mass is compressed as it nears an opening which has a length equal to

that of the grid to be pasted. The grids are passed across the opening by rolls, have their cavities filled with the red lead which is being forced out, and then pass between wheels whose distance apart is equal to their thickness, where they are polished, the grids coming from the machine with their perforations filled with paste of an equal density at every point. The different rolls and wheels, and the screw, are geared together, so that their relative speeds are invariable.

The method of manufacturing the support plates, or 'grids,' has also been improved upon. The old method was simply to cast them; and, although the process was a cheap one, yet the plates lacked in strength and density. Mr. Madden has devised a press by which they are formed by hydraulic pressure. Besides the advantages of greater density and homogeneity, giving an improved strength and conductivity, the process allows smaller holes and thinner partitions than can be obtained by casting.

These improvements in manufacture should result in a greatly reduced cost, and in an increased efficiency and length of life. Storage-batteries are just at the point of becoming economical for many purposes, and a moderate reduction in cost and depreciation will turn the balance.

NEW STREET-CAR MOTOR OF THE SPRAGUE COMPANY. — Since the beginning of the year, the Sprague Electric Railway and Motor Company has equipped a number of street-railways with electric-motor cars, some of the installations having been difficult and important. The result of the year's experience has been the adoption of a motor differing considerably in type from that heretofore used, which has been described in this journal. In the new form a single magnetic circuit is used, as in the Edison dynamos, the axle of the car passing through bearings on the yoke. At the other end the poll-pieces are suspended from a cross-piece on the truck by a heavy spiral spring. Another spring below prevents the motor from rising when the motion of the car reverses. The motion is transmitted from the armature to the wheele-axle by two pairs of gears, — one on each side of the car, — one of the wheels in each case being of fibre to deaden all noise. The reduction is 12 to 1. There are two commutators on each armature, — one at each end, — with a single brush for each. The object of this is to have all the brushes on top, where they can be easily adjusted and inspected. It also decreases the wear. The old form of brush consisted of a number of strips of copper riveted together, and set at a slight angle with the commutator bars. This allowed the direction of rotation to be reversed; but there was more or less wear, especially when the armature revolved against the brushes. In the new brush a number of thin laminæ of copper are strung on a rod in a bevelled holder, and bear almost straight down on the commutator. inclining slightly in the direction of motion. When the machine is reversed, the strips are first carried up to the vertical, and then a little past it in the new direction of rotation, until brought up by the inclined sides of the holder. The motors are controlled as formerly, by switches on the two platforms of the car, and the cars are intended to travel in both directions. The whole arrangement is compact, and should be extremely efficient. It is an improvement on the old type of motor, which has been very successfully used.

ELECTRICITY FOR TEMPERING STEEL. — Electricity has been successfully applied for tempering watch-springs and other forms of spring steel, whether in the form of ribbon or wire. The steel is wound on a spool, whence it passes down through a bath of oil. An electric current is sent through the wire, of such strength as to keep it at the proper redness to answer the desired requirements of temper. As the heating is not done in contact with the air, but is entirely beneath the surface of the oil, there is no trouble from blistering, as in the ordinary methods. The final temper is drawn in the same manner, and the wire or ribbon is finished by means of rolls. The process is also applied to a number of springs besides those for watches, including piano-wires. In all cases the process can be controlled to a nicety, both as to the exact temper and its uniformity through the wire.

STANDARDS OF LIGHT. — The committee of the British Association, of which Prof. Vernon Harcourt is chairman, has submitted a report on comparative tests of standards of light. These tests, made on six classes of standards, have been carried on for four years, and as a result the committee recommends the pentane lamps. Ordinary sperm candles vary, because the sperm is not a definite chemical compound; and the luminosity varies with the composition, and the locality and length of the wick. The flame is also liable to fluctuate. It is difficult to obtain sperm candles perfectly free from oil. Perfectly dry sperm has a comparatively high melting-point, and candles made of such material require a thicker wick; so that candles of the same size made of this material give less light than those formerly accepted as standards. The amylacetate lamps are constant, but their reddish light is against them. The pentane standard is reliable: it has no wick, and the light does not alter with slight variations in the specific gravity of the pentane. In a special series of comparative tests as to the merits of the amylacetate lamp, the pentane standard, and the pentane lamp, the pentane lamp was found almost as good as the pentane standard. Three observers recorded the results, and changed their positions after each set of simultaneous observations. The pentane lamps differed, in a total of 1,118 tests, by 1 per cent in 86 cases, by 2 per cent in 57 cases, by 5 per cent in 19 cases, and in a few instances by 10 per cent. Other tests were made to reduce the platinum unit of M. Violle — the light given off by a square centimetre of platinum at its melting-point — to a practical shape. Platinum-foil with a surface of a quarter of a square inch was stretched over rollers and heated to its melting-point, but the results were too variable to be of value. When wound over steel rollers, the heat was conducted away too rapidly. Experiments with platinum fused by the blowpipe were equally unsatisfactory. The heating of a platinum strip by the current of eight or ten accumulators gave better results, but the platinum is apt to buckle. Other lamps and flames were also tried. Carbon filaments waste, nor would the action of photographic rays on sensitive-plates lend itself to standard tests. The committee therefore recommends the pentane standard and also the pentane lamp.

EFFECT OF ELECTRIC CURRENTS ON PLANTS. — Prof. E. Wollny of Münich has experimented on the effect of electric currents of different intensities and characters on the growth of plants. Small plats of about four metres square were provided, and were separated by plates penetrating twenty-five centimetres into the soil. On the two sides of one of these beds, plates of zinc were sunk, the dimensions being thirty centimetres by two metres. They were connected by an insulated wire, with five Meidinger cells in the circuit. Another enclosure had an alternating current constantly sent across it, while in a third there were simply buried a copper and zinc plate connected above the earth by an insulated wire. The three enclosures were therefore subjected to different conditions,— to a weak direct current, to a comparatively strong direct current, and to an alternating current. Several specimens of grain, potatoes, carrots, etc., were planted, and were subjected to the action of the currents until they reached maturity. Comparing them with plants grown under ordinary conditions, the result to which Professor Wollny is led is, that electricity, whether under the form of continuous currents of different intensities or of alternating currents, exerts no influence on the vegetation of plants.

HEALTH MATTERS.

Depressed Areas as Health-Resorts.

DR. WALTER LINDLEY of Los Angeles, Cal., contributes to the *New York Medical Record* an interesting paper on the effect upon invalids and others of compressed air below the sea-level. He says that in the eastern part of San Diego County, about one hundred miles from Los Angeles, is a depression traversed by the Southern Pacific Railroad, known to geographers as the San Felipe Sink, but commonly called, on account of the innumerable shells spread over its surface, the Conchilla Valley. This basin is about one hundred and thirty miles in length by thirty miles in average width. The deepest point is about three hundred and sixty feet below sea-level.

In this valley live about four hundred of the Cohuilla Indians. This is an interesting tribe. Dr. Stephen Bowers, in a paper read before the Ventura County Society of Natural History, March 5,

1888, said that he believed them to be of Aztec origin. They are sun and fire worshippers, and believe in the transmigration of souls, and that their departed friends sometimes enter into coyotes, and thus linger about their former habitation. They practise cremation. Their principal article of food is the mesquite-bean, which they triturate in mortars of wood or stone, after which the meal is sifted; and the coarser portion is used as food for their horses and cattle, and the finer is made into cakes for family use. Dr. Lindley found, on a visit here, asthmatics, rheumatics, and consumptives, all of whom reported wonderful recoveries. Some of these stories he accepted *cum grano salis*, which quotation is, by the way, especially applicable to the salt-fields. These asthmatics and consumptives claim that the farther they get below sea-level, and the dryer the atmosphere, the easier they breathe. The rheumatics claim that the heat and dryness improves the circulation, and thus relieves them. Dr. Lindley did not stay long enough to make any trustworthy observations; but he thought, that, aside from dryness — mean annual relative humidity certainly not over twenty-five — and equability, there was considerable atmospheric pressure at a point three hundred and fifty feet below sea-level, and that there was here moderately compressed air on a large scale. In a recent paper on the use of the pneumatic cabinet, the author, from many cases in practice, showed that compressed air relieves asthmatics and cases of phthisis. He says the compressed air will gradually force its way into every part of the lung, in order that the pressure may be the same on the inside as on the out. While the proportion of oxygen is, of course, not increased, yet there is an increased quantity in a given space, and we really have the oxygen treatment here on an extensive scale.

In connection with his paper, Dr. Lindley adds an interesting note in which he gives the following list of other places below sea-level: "Sink of the Amorgosa (Arroyo del Muerto), in eastern California, two hundred and twenty-five feet below sea-level; the Caspian Sea, eighty-five feet below sea-level. Lake Assal, east of Abyssinia in the Afar country, eight miles long and four miles wide, is about seven hundred and sixty feet below sea-level. Its shores are covered with a crust of salt about a foot thick. This salt is a source of revenue to the Afars, as they carry it by caravans to Abyssinia, where they find a ready market. There are several other depressions about six hundred feet below sea-level in this vicinity. The noted oasis Siwah, in the Libyan desert, three hundred miles west of Cairo, is one hundred and twenty feet below sea-level. Here are beautiful date-palm groves, and here also the apricot, the olive, the pomegranate, and the vine are extensively cultivated. In this same desert is the oasis Araj, two hundred and sixty-six feet below sea-level. There are also numerous other depressions in the desert portion of Algeria and at various points on the Sahara Desert."

Garbage-Cremation.

Our readers who are interested in garbage-cremation will find an excellent paper on this subject in the *Journal of the American Medical Association*, Oct. 13, 1888. The author of the paper is Dr. J. Berrien Lindsley of Nashville, Tenn. Dr. Lindsley is the treasurer of the American Public Health Association, and has made the cremation of garbage a special study. The difficulties connected with the disposition of a city's refuse may be imagined from the following statistics which he gives: —

Baltimore, August, 1887, estimated by police census, had a population of 437,155. The amount of night-soil delivered at the dumps for the year ending Dec. 31, 1887, was 51,107 loads, or 10,221,400 gallons. Probably more than half the inhabitants use water-closets, which carry off an equal amount. The dead animals, etc., removed during the same year were:

Total number of dead animals	25,249
" " " " fowls	9,074
" " " " fish	23,574
" " " cartloads of dead fish, vegetable and other offal removed from various docks.	1,067
" " " pounds of decayed meat condemned	1,495
" " " dozens of eggs condemned	607

Richmond, population 100,000. The report of contractor for removal of garbage, or kitchen refuse, year 1887, shows total number of loads carried off, 2,680 = 72,200 bushels.

Memphis, population 62,335. Number of loads of garbage removed in 1887 was 29,120.

In this country the experiment of destroying garbage by means of a furnace constructed especially for that purpose was first tried on Governor's Island, New York harbor. A description of this garbage-cremator was given in the *Sanitary Engineer* of Aug. 13, 1885, by Lieutenant Reilly, at that time acting assistant-quartermaster, United States Army.

In the twelfth volume of 'Public Health,' containing the reports and papers presented to the American Public Health Association, at the Toronto meeting, October, 1886, may be found a paper by Dr. George Baird of Wheeling, giving an account not only of the destruction of garbage, but also of night-soil, by means of a furnace contrived by M. V. Smith, M.E., Bissell's Block, Pittsburgh, Penn. In the 'Report on the Sanitary State of Montreal, for the Year 1886,' will be found an interesting narrative in this connection, giving instructive details as to cost, showing the extent of the work to be done, and the complete success of the refuse-crematories, and also of the night-soil crematories constructed by Mr. William Mann. Dr. Louis Laberge, health-officer of Montreal, read an elaborate paper on this topic at the meeting of the American Public Health Association in Memphis, last November, which will be found in the thirteenth volume of 'Public Health,' now in press. The *Sanitary News* of Nov. 19, 1887, states that at Des Moines, Io., a small Engle furnace is in experimental use, and is working very satisfactorily. At Pittsburgh a Rider furnace has just commenced its service. In Chicago a Mann furnace was being constructed. In the same journal, March 17, 1888, may be found a full description of the Chicago garbage-crematory, from which a duplicate of the plant could be built if desired. On April 14 it reports that the said crematory is doing good service in disposing of about fifty tons of material a day. The *Sanitary News* of March 10, 1888, reports the success of the disposal of garbage by cremation at Milwaukee.

HEALING OF WOUNDS.— Prof. Leon Le Fort believes that the impurity of the air has no injurious effect upon wounds, and that it may be ignored. He believes that wounds will successfully heal if perfect cleanliness is maintained by the surgeon, as to his person, and every thing used by him in his operation.

LEAD-POISONING.— Dr. Herald of Newark, N. J., has, during the past six months, had fifty cases of lead-poisoning in his practice, which he has traced to soda-water contained in the five-cent patent-stopper bottles. In some of the stoppers examined by him he found 42.4 per cent of lead, and in others 83.6 per cent. The action of the carbonic acid in the water upon the lead in the stopper ultimately produces a bi-carbonate of lead, which, when absorbed from the stomach, causes lead-poisoning.

POTATO-POISONING.— A large number of soldiers were recently poisoned while on duty at one of the French fortifications. It is believed that the solanine in unripe potatoes was the cause of the sickness.

ETHNOLOGY.

The Laws of Marriage and Descent.

AT the recent meeting of the British Association, Dr. E. B. Tylor read an interesting paper on the laws of marriage and descent, illustrative of his ingenious method of studying ethnological phenomena. All myths and customs, on a close study, may by analysis be disintegrated, and are found to consist of certain elements. Dr. Tylor arranges these elements statistically, and, by inquiring which occur simultaneously among various peoples, proves that certain groups of such elements belong genetically together. This he calls the method of adhesions. The results thus obtained are of the greatest importance from a psychological as well as from an historical standpoint. As a test of the results to be obtained by this means, he examines the custom which forbids the husband and his wife's parents, although they may be on a friendly footing, to speak or look at one another, or mention one another's names. Some seventy peoples practise this or the converse custom. On classifying the marriage rules of mankind, Dr. Tylor found that the avoidance custom between the husband and the wife's family belongs preponderantly to the group of cases where the husband goes to live with

his wife's family. This happened in fourteen cases, while if distributed by chance it would have happened in eight cases only. This implies a causal connection between the customs of avoidance and residence, and suggests as a reason, that the husband, being considered an interloper in the wife's family, must be treated as a stranger, or, as we should say, "he is not recognized."

The custom of naming the parent from the child prevails among more than thirty peoples: thus Moffat was generally known in Africa as Ra-Mary, or father of Mary. This custom proves, on examination, to adhere closely to those of residence and avoidance, the three occurring together among eleven peoples; that is, more than six times as often as might be expected to happen by chance occurrence. The connection of these customs finds a satisfactory explanation in the accounts given of the Cree Indians, where the husband lives in his wife's house, but never speaks to his parents-in-law till his first child is born. This alters the whole situation; for, though the father is not a member of the family, his child is, and when he receives a new name, meaning 'father of the new-born child,' the whole is brought to a logical conclusion by the family recognizing him as soon as he takes this name.

Dr. Tylor has inquired into the two great divisions of human society, — the matriarchal and patriarchal, or, as he prefers to call them, the maternal and paternal systems. In the former, descent and inheritance follow the mother's side, and the guardian of the children is the maternal uncle, not the father, whose assertion of paternal rights belongs to the paternal system with descent and inheritance on his side. The problem to be solved is, which of the two systems is the more primitive? Former inquirers have judged that the maternal system is the earlier; but Dr. Tylor is the first to give a firm basis to this theory by showing numerically that frequently customs of the maternal stage survive in the paternal, while no instance of the reverse is known. The author believes that a chief underlying cause of both these systems is still traceable in society. His tables show that among 65 peoples the husband attaches himself permanently to his wife's family; among 76 such, temporary residence is followed by removal to a paternal home; and in 151 cases the paternal home is resorted to from the first. The changes brought about by the man ceasing to be in the hands of his wife's kinsmen, and becoming lord of a household of his own, he considers as the cause of transformation of maternal into paternal society.

These results of a comparatively limited application of Dr. Tylor's ingenious method prove that it is pre-eminently adapted to the study of human institutions and inventions, and will undoubtedly prove a great help in the study of the history and development of mankind.

DISCOVERY OF FLINT IMPLEMENTS AT SOUTHALL, ENGLAND. — In the May number of the Proceedings of the Geologists' Association, John Allen Brown describes the discovery of the greater portion of a mammoth associated with human relics under circumstances of more than ordinary interest. The geological formation of this district being well known, the author was able to ascertain with a reasonable degree of exactness the probable origin of these remains, particularly the circumstances under which the carcass was deposited, and how it happened that its immediate neighborhood proved to be so rich in human relics. He shows that either the banks of a large river of the past must have existed near the spot, or the rising ground of an island in the stream. The mammoth either drifted into the shallow, tranquil water close to the bank, or was driven into the clayey silt of the shore, in which its remains were found by the paleolithic hunters who have left us so many of their implements as evidence of their presence in this locality at the time. The occurrence of so many implements at about the same level is indicative of an old inhabited land surface in their immediate vicinity, especially as most of them show little effect of rolling with the stones of the gravel, and have not been carried far, if removed at all, by the stream. A spear-head found in contact with the bones leads directly to the conclusion that it had actually been used, with others, for hunting the animal or cutting into its flesh. At any rate, it seems difficult to avoid the inference that there is an historical connection between the remains of the elephant and the implements found in such close proximity to them. The subsequent alteration in the currents, and probably in the channel of the stream, by which these interesting relics of the remote past were covered up, tells the same tale of old habitable land surfaces, inundated, eroded, and destroyed, and new ones formed, which is noticeable all over the Thames valley.

BOOK-REVIEWS.

A Handbook to the Land-Charters, and other Saxonic Documents. By JOHN EARLE. Oxford, Clarendon Pr. 12°. (New York, Macmillan.)

THIS book will be very valuable to students of the early history and institutions of England. The author's name is sufficient guaranty for the general accuracy of the work, and the selections he here gives have both historical and philological value. They are mostly grants of land, either from the King in council or from some subordinate authority; some of them being made to individuals, and others to religious houses. The land of the Teutonic settlers in England was at first divided into three portions: one being assigned to individuals, and made hereditary in their families; another given to townships as a corporate possession; while the third remained the property of the nation, under the name of 'folk land.' It was from this last portion that the grants here dealt with were made, subject always to the three burdens of military service, repair of bridges, and repair of fortresses. The greater part of the extant documents are grants to religious bodies, owing, as Mr. Earle remarks, to their having a better chance of preservation. The great importance of such title-deeds, and the difficulty in early times of detecting spurious ones, led to the forgery of many; and Mr. Earle gives examples of these of a real date subsequent to the Norman Conquest, but professing to be centuries older. The greater part, however, of his selections are genuine documents, and their historical importance is obvious. He has not confined himself, though, to land-grants, but gives examples of wills, contracts, and other papers of interest. They are all written either in mediæval Latin or in Anglo-Saxon, or more often in a mixture of the two; and, as an aid to their study, the author gives a glossary of the Saxon words, and of such Latin words as require elucidation.

In his introduction, Mr. Earle treats the general form and character of the charters, and then takes up the subject of land-tenure in those early times, discussing particularly the origin of the lord of the manor. The old theory of Blackstone and others was, that the lord was the original owner of the soil, and that some of his tenants succeeded in acquiring a customary right to the lands they held of him, which afterwards developed into a legal right. On the other hand, the historical school maintains that the township, or village community, was the original land-owner, and that the manorial lords of later times were usurpers. Mr. Earle's view is different from either of these. He holds that there was from the very first settlement of the Germanic tribes in England a class of military chieftains known at first as *gesithas*, and afterwards as *thanes*, one of whom was, as a rule, attached to each township. They were commissioned officers of the King, having military and police duties to perform, and wielding a certain authority over the township for that purpose. They were in no sense proprietors of the town lands, but had certain land of their own in the neighborhood; and it was these officers who afterwards developed into the lords of the manor. This theory is not free from difficulties, as the author himself recognizes; but it is certainly plausible, and well deserves the attention of historical students.

Tenure and Toil. By JOHN GIBBONS. Philadelphia, Lippincott. 12°. $1.50.

THIS work is another of those attempts, now so common, to cure all the ills of the body politic. Mr. Gibbons is impressed with the evils that flow from poverty and the unequal distribution of wealth, as well as with those attending the conflicts of labor and capital; and, like many other persons, he exaggerates them till they appear of portentous dimensions. Those evils, he thinks, arise from "the false relations existing between the people and the land, and between labor and capital;" and the remedy for them "can be found only in legislation." The remedies he proposes, however, are for the most part such as have been proposed by others, and those that are new do not strike us as either wise or adequate to

their purpose. He is a firm upholder of the right of property, in land as well as in any thing else; but he would limit the amount of land that a man might own. In reply to the objection sometimes urged against land-reformers, that men will often refuse to take land even when they can get it for nothing, he proposes that men without means of support shall be compelled to go and settle on the public lands in the West, the government to advance them the necessary capital to begin farming with, the same to be paid for by them in instalments. He would have arbitration by State officers between labor and capital, but would not compel the parties in dispute to accept their decision. He recommends some minor measures in the interest of the laborers, and favors profit-sharing and co-operation. The combinations of capital known as 'trusts' he regards with strong dislike, and would have them all abolished by law. Such are the principal measures he proposes, and, except the one about the public lands, they contain little that is new. The real defect in them, as in so many others that have been proposed, is that they overlook the moral and intellectual causes to which the evils complained of are so largely due, and which cannot be removed by legislation. We should add that a considerable part of Mr. Gibbons's book is taken up with a history of the institution of property, which is not always up to the standard of the best scholarship, as, for instance, when he cites the early chapters of the Pentateuch as historical authority. Indeed, the whole book gives the impression that the author either lacks the ability or has not taken the trouble to master his subject.

Inebriety: its Causes, its Results, its Remedy. By FRANKLIN D. CLUM, M.D. Philadelphia, Lippincott. 12°. $1.25.

THE author states in his preface that "the object of this book is to give a clear, correct, and impartial description of drunken frolics, their consequences, and how to avoid them. The subject is treated from a scientific standpoint, and the drunkard is pictured in colors that are true to life. His habits, his diseases, his misfortunes, his miseries, are described exactly as we find them, and the easiest and best way to cure and reform him is made known so simply and clearly that all can understand."

With the habits, diseases, misfortunes, and miseries of the drunkard, we imagine that the readers of this book are as familiar as its writer, and we therefore pass these subjects by; but in the cure and reform of the inebriate every one is interested; and if, as Dr. Clum states in his preface, he has found a way of accomplishing this, he has done humanity a great service, and doubly so if that way is an easy one. Of his ability to accomplish this transformation he is evidently thoroughly convinced. In addition to the quotation already made, he further says, "The most confirmed and degraded drunkard can be reformed if the directions given in this volume are carefully carried out. They can be carried out by even the most poverty-stricken man, if there is an honest desire in his heart to reform."

The author's method of reforming the drunkard may thus be concisely described. The first object to be obtained, in all cases, is the personal consent of the inebriate to assist in his own reformation. He should carefully think the matter over, until there is no lingering doubt in his mind about the injury alcoholic drinks are doing him. He should understand the reasons, and all the reasons, why they are not good for him. Then he should avoid the thoughts, the persons, and the places that lead to the temptation to drink, and frequent the places, associate with the persons, and indulge in the thoughts, that lead away from the temptation. He should keep busy at something that will occupy his close attention, and not become discouraged and give up the struggle, even though he should break his resolution time after time. When the resolution has been broken, he should carefully think the matter over until he understands why he failed, so that he may be on his guard against a recurrence of the same circumstance. Dr. Clum especially insists upon the treatment of drunkards as matter-of-fact men, and not as if they were the most demoralized, sinful, and abandoned of men; nor, on the other hand, must they be treated as if they were objects of great pity. They will listen to philosophical reasoning, to plain, unvarnished truth, but despise trickery and hypocrisy. After intoxicants have been discontinued, steps should be taken to restore the inebriate's health, and his surroundings should be made sanitary. His occupation and residence may often be changed with advantage. The views of the author, which we have endeavored to give in a condensed form, are, of course, fully elaborated in his book. He gives some sound advice to the moderate drinker as well as to the confirmed drunkard, warning him that he is in danger. He should remember that he has the same failings, passions, and frailties as other men, and is subject to the same physiological laws, disappointments, sorrows, and diseases, and that it is absolutely impossible for a moderate drinker to tell with certainty whether he will become a drunkard or not. His only safety is in avoiding intoxicants *in toto*.

One chapter of Dr. Clum's book is so remarkable, that, although we have already extended our consideration of his views more than we had intended, we must take a moment to refer to it. In the chapter referred to, which is headed 'The Inebriate Drunkard's Guide,' the writer gives advice to the drunkard, so that while he continues his habit he may do so with the least injury to his health, and thus prolong his life. Whatever may be thought of the wisdom of this, Dr. Clum recognizes, that, despite all warnings, protestations, pleadings, and tears of friends, many persons will continue to indulge in alcoholic drinks. The rules which he lays down for the guidance of such persons are as follows: 1. Alcoholic drinks, especially strong spirits, should not be taken on an empty stomach; 2. Light, dry wine, beer, or ale should be drunk in preference to strong spirits; 3. Whenever disease exists, those wines should be used which will create the least mischief, as, in gout, sherry or madeira instead of hock and claret, or the best quality of light California wines; 4. Champagne should be preferred as usually the safest; 5. Liquors should not be mixed. Other advice follows in reference to bathing, and the care of the body and its functions. The author is evidently aware that some persons may be tempted to make use of the directions which he gives to continue the evil habit, and at the same time to minimize its effects; for he says that it is to be hoped that those who have just started on their career as drunkards, and are not fully initiated in the mysteries of Silenus, will not attempt to follow these rules with the intention of being moderate drinkers, thinking to escape the disastrous effects, the terrible penalties, and the fearful evils of drunkenness. Moderate drinkers engaged in business calling for judgment and acumen, end, with scarcely an exception, as financial wrecks, however successful they may be in withstanding the physical consequences of their indulgence. From a careful perusal of Dr. Clum's book, we infer that he believes that an inebriate may be cured if he is determined to reform, but that without this determination any attempt at reformation will be a failure.

Hand-Book of Moral Philosophy. By HENRY CALDERWOOD. 14th ed. London and New York, Macmillan. 12°. $1.50.

THE sale of fourteen thousand copies of Professor Calderwood's 'Moral Philosophy' is pretty good evidence that it contains something of real value, and all who have read the book will agree that this is the case. It is not, and does not profess to be, a great original work, laying down a new theory of our moral nature or of moral truth, but only a compendium of the best ideas of the intuitional school; and as such it is a decided success. It is much superior to the ordinary ethical text-book, especially in depth and closeness of reasoning. The author, too, though decided in his own views, is eminently fair in representing those of his opponents, and often keen and able in criticising them. The present edition of the 'Handbook' is largely rewritten, especially the chapters dealing with the basis of morals, and those in which the author criticises the Hegelians and the evolutionists. The chapter on the 'First Cause,' too, is enlarged, which, from a literary point of view, seems a mistake, as introducing matter not strictly ethical; for, though duties to God must obviously be treated in an ethical work, the subject of the divine existence and attributes belongs to another branch of philosophy. On the other hand, some topics are not accorded the space they deserve, the chapter on 'Impulses to Action,' for instance, being by no means so full and elaborate as would be desirable. On the whole, however, the work deserves its reputation, and we are glad to see it appearing in a revised form, better adapted to the wants of the present time.

Professor Calderwood's philosophy, as we have already remarked,

is the intuitional; and the largest and best portion of his work is devoted to setting forth the intuitional theory of conscience and the moral law, with criticisms of opposing views. In so doing he reveals both the strength and the weakness of his own position. The grand defect in the utilitarian ethics has always been its failure to account for the sense of obligation; and Professor Calderwood has no difficulty in showing that all their attempts to derive this sentiment by association or evolution from the lower feelings of our nature have thus far been unsuccessful. In discussing the views of the Hegelians and Neo-Kantians, our author has the same difficulty that others have in understanding what they mean by 'self-realization,' and how this can be made the basis of moral conduct. Professor Calderwood's own theory, however, has in our eyes a defect hardly less momentous than those he points out in the others; namely, its failure to reduce the moral law to one fundamental principle. Our conscience, he says, knows intuitively that we ought to be industrious, truthful, temperate, and so forth; but each of these is given as a distinct and independent law, having no connection with the rest. He maintains, indeed, that all the various moral laws are in perfect harmony with one another; but, if this is the case, there must be some deeper principle on which that harmony depends, and this principle must be the fundamental moral law. It is obvious, however, that a purely intuitional ethics, which rejects all reference to ends, can never supply such a principle, but we must look for it in some other direction.

Western China: A Journey to the Great Buddhist Centre of Mount Omei. By Rev. VIRGIL C. HART. Boston, Ticknor. 12°. $2.

THE author of this interesting description of western China and its temples and sceneries is so well versed in the Chinese language, and so well acquainted with Chinese customs, that his book cannot fail to be full of material of the greatest interest. During a twenty-two years' residence in China, more particularly in the central parts of the empire, he has acquired a thorough knowledge of the religion of the Chinese, and therefore his descriptions and explanations of the great religious centre in western China are full of interest to the student of Buddhism. In 1887 the author was appointed to visit western China and re-open a mission at Chung King, which had been destroyed by a mob. After re-establishing the mission, he made a visit of a month's duration to Mount Omei, which is one of the great centres of Buddhistic worship. It is the adventures of this journey and his observations on Mount Omei which the author describes in his book. The produce of the districts he visited, and the mode of life and the trades of the inhabitants, as well as the wonderful scenery of the gorges of the Yang-tse, are the subjects of the author's interesting descriptions. But the reader will be especially attracted by his observations on the wonderful works of art in this region. The author says, "Here, near the borders of Chinese civilization, we find a region of unequalled sublimity, a combination of lofty mountains, of swift rivers, of valleys of wondrous fertility. Then, also, of the works of man there are many, such as thousands of brine-wells, a great silk-culture, of which it is the centre, a white-wax industry, mountains chiselled into the forms of idols, colossal bronze statues, pagodas, and one temple wholly of rich bronze." Valuable translations of Chinese inscriptions found in these regions make the author's descriptions still more interesting, opening, as they do, a view upon the ancient history of this district, and upon the state of mind in which the pilgrim gazes at these works of religious devotion.

Elementary Classics. London and New York, Macmillan. 24°. 40 cents each.

THREE new volumes of this useful series have reached us. Rev. G. H. Nall has edited 'Stories from Aulus Gellius,' with notes, exercises, and vocabularies for the use of lower forms, and intended as a pleasant change to young boys after a course of 'Cornelius Nepos,' and 'Eutropius.' The language of the original has been simplified in part, and some rare or late words and constructions have been cut out. Rev. H. M. Stephenson has edited the fourth book of the 'Æneid' on the same plan as the ninth, which was published a short time ago. The third volume of the series are selections from Xenophon's 'Anabasis,' Book IV., edited by Rev. E. D. Stone, and accompanied by an historical introduction, notes, exercises, and a vocabulary. This special portion has been selected as a record of hardihood and adventure likely to be of special interest to boys.

Talks on Psychology applied to Teaching. By A. S. WELCH. New York and Chicago, E. L. Kellogg & Co. 16°.

THE present little volume has been written from an educational point of view, its object being to give a review of psychology as applied to teaching. Many instructors in our common and graded schools are familiar with the branches they teach, but deficient in knowledge of the mental powers whose development they seek to promote. The teacher, however, must comprehend fully not only the objects studied by the pupil, but the efforts put forth in studying them, the effect of these efforts on the faculty exerted, and their result in the form of accurate knowledge. These have been the leading considerations in determining the character and scope of the book. The first part of the book is a brief summary of psychological data, while the second contains their special application to teaching-purposes.

A First Book in German. By H. C. G. BRANDT. Boston, Allyn & Bacon. 12°. $1.

THE present volume is the first part of Brandt's 'German Grammar,' bound together with 'The Student's Manual of Exercises,' prepared and arranged by A. Lodeman to accompany the former. Thus a book is obtained that is well adapted for use in secondary schools. The first part is an unaltered reprint from the fourth edition of the grammar, which is very concise and clear. Accidence and syntax are completely separated. The syntax is treated to a certain extent from an historical standpoint. Although in the first part only brief remarks on this subject are found, they will interest the pupil. The present partial edition has been prepared at the suggestion of teachers, and will undoubtedly prove very useful.

Macmillan's Greek Course. London and New York, Macmillan. 16°.

MR. H. G. UNDERHILL has compiled a series of 'Easy Exercises in Greek Accidence,' and Mr. W. Gunion Rutherford has used the occasion to prepare a new edition of his 'First Greek Grammar,' which, in its general arrangement, remains as the former editions, although it has been thoroughly revised and partly rewritten. The first part of the grammar is a drill-book for beginners, "more accurately compiled than those generally in use," while all advanced matter is confined to a second part. The grammar, in its original form, gained many friends, and it has become still more useful in its revised form, and by the addition of the collection of exercises by Mr. Underhill, of which it is the starting-point.

NOTES AND NEWS.

THE committee on science and the arts, of the Franklin Institute of Pennsylvania, is empowered to award, or to recommend the award of, certain medals for meritorious discoveries and inventions. These medals are (1) the Elliott Cresson medal (gold), founded by the legacy of Elliott Cresson of Philadelphia; and (2) the John Scott legacy premium and medal (twenty dollars and a medal of copper), founded in 1816, by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the city of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. Upon request made to the secretary of the Franklin Institute, Philadelphia, full information will be sent respecting the manner of making application for the investigation of inventions and discoveries.

— In his annual report, Surgeon-General Moore says of the health of the United States Army that the mean strength of the army for the year, including officers and both white and colored enlisted men, is stated at 23,841, of which 21,601 were whites and 2,240 were colored. The total admissions to sick report were 29,727 (white, 26,600; colored, 3,127); ratio of all admissions per 1,000 of all mean strength, 1,231.42 white, and 1,395.98 colored; deaths from all causes, 188 white, 26 colored, — total, 214; ratio of deaths per 1,000 of mean strength, 7.88 white, 10.71 colored, — total 8.12. The death-rate was somewhat lower than the rate for the previous decade, which was 11.4. The death-rate of the

army of the United States continues to be higher than that of any foreign armies, except the British and Italian. The principal causes of deaths were pneumonia and shot-wounds.

— Dr. William Osler, professor of clinical medicine in the University of Pennsylvania, has been appointed physician to the Johns Hopkins Hospital, and professor of medicine in the Johns Hopkins University. Dr. Osler took his degree in the McGill University, Montreal. He subsequently studied in London, Berlin, and Vienna, and in 1885 was appointed Gulstonian lecturer in the Royal College of Physicians, London, and in 1886 Cartwright lecturer in the College of Physicians and Surgeons, New York.

— Prof. Simon Newcomb has gained great benefit from his sojourn at Chelsea Hospital, and has now gone to Asheville, N.C., accompanied by his daughter, for the purpose of enjoying the fresh mountain air there.

— Major J. W. Powell, at the meeting of the Philosophical Society of Washington last Saturday, read a paper on 'The Laws of Corrasion,' explaining their methods of operation under various conditions; Prof. E. B. Fernow also read a very important paper on 'The Influence of Forests upon Quantity and Frequency of Rains.' The full text of the former, which is a very important discussion of a law first definitely announced by Major Powell in his letter to the New Orleans Chamber of Commerce, and a full abstract of the latter, will be published in early issues of *Science*.

— The wisdom of the policy of Surgeon-General Hamilton in establishing a camp of refuge for persons fleeing from points infected with yellow-fever is amply vindicated by the record of Camp Perry. The following despatch from Dr. Hutton, who is in charge of the camp. gives some interesting facts: "Oct. 20: To-day completes two months at Camp Perry; 810 refugees from infected points have been received; 721 have been discharged; 25 cases of fever developed; 1 death Sept. 9; not a case contracted in camp. Our 60 unacclimated employees, 5 of whom have been two months in fever-camp, not a single case of fever of any kind among them. Not a known case of fever reported from the 721 cases discharged and scattered to all parts of the country. In view of these facts, how any sanitarians can consider Camp Perry as an infected place is incomprehensible. Drs. Faget and Posey of New Orleans, Guitéras, and Geddings give this their emphatic indorsement."

— Messrs. James W. Queen & Co., Philadelphia, have just issued a new catalogue of chemical apparatus. In this they have omitted reference to old and obsolete forms, and endeavored to make a catalogue the most complete and useful ever issued in this country. The catalogue will be mailed to any address on the receipt of fifty cents. The firm has added to its manufacturing facilities, and is prepared to make all kinds of scientific apparatus. Their facilities for making platinum ware are especially to be noted.

— The autumn meeting of the American Oriental Society in Philadelphia, Wednesday, Oct. 31, was the first to be held in that city, the society accepting at its May session the invitations extended on behalf of the University of Pennsylvania and the Oriental Club of Philadelphia. On Wednesday, at 3 o'clock P.M., the society met in the chapel of the University of Pennsylvania; and on Thursday morning and afternoon, in the hall of the Historical Society. The following is a list of the papers read: 'Report on the Exhibit of Oriental Antiquities of the Cincinnati Exposition,' by Cyrus Adler; 'On a New Testament Manuscript, Peshito Version, dated A.D. 1206, with a Text of the Traditions of the Apostles,' by Isaac H. Hall; 'A New Vedic Text on Omens and Portents,' by J. T. Hartfield; 'Qualitative Variations, in the Calcutta and Bombay Texts, of the Mahabharata,' and 'On the Later Puranas (in Sanscrit Literature),' by E. W. Hopkins; 'A New Reference in the Avesta to "the Life-Book" Hereafter,' by A. V. W. Jackson; 'On Transposed Stems in the Babylonian Talmud,' by Marcus Jastrow; 'On a Fragment of the Grammatical Works of Abu Zakarijjah Hajjug,' and 'On Symbols of the Sun-God and the Word *Kuduru*,' by Morris Jastrow, jun.; 'On a Samaritan Hebrew Manuscript in the Library of Andover Seminary,' by George F. Moore; 'On Rome Assyrian and Babylonian Royal Prayers,' and 'The Pantheon of Assur-banipal,' by D. G. Lyon; 'Remarks on the Arabic Dialect of Cairo,' by C. H. Toy; 'The Babylonian Caduceus,' and 'A Babylonian Cylinder from Urumia,' by William Hayes Ward; 'Note on the Arch of Chosroes,' by Talcott Williams. Reports were read on 'The Collection of Oriental Antiquities recently deposited in Washington,' by one of the curators of the National Museum; and on 'The Recent Purchase of Cuneiform Tablets for the University of Pennsylvania,' by a member of the Chaldean Exploration Party.

— The Colorado Ornithological Association has been re-organized under the title of 'Colorado Biological Association.' Its objects are the detailed investigation and recording of the fauna and flora of Colorado, recent and fossil. Annual reports and special bulletins will be issued. The former are to contain a full bibliography of the published records for the State during the year. Mr. T. D. A. Cockerell of West Cliff, Custer County, is secretary of the association.

— Benjamin B. Chamberlin, who has recently died, was born at Keeseville, Me., March 13, 1831. He was the son of the Rev. Parmalee Chamberlin, a Methodist clergyman, formerly well known in New York. After leaving school, he was apprenticed to Benjamin J. Lossing, then an engraver in New York, and subsequently went to Cincinnati to embark in business for himself. About 1865 he returned to New York. While in Cincinnati he turned his attention to collecting, his first hobby being medallions; and after his return to New York he took up the study of minerals, making a specialty of collecting those of New York and vicinity. For this work he had exceptional facilities, as the Fourth Avenue improvement was then in progress, and blasting was going on in many parts of the city now built over. He leaves one collection at the Nyack Library. His foreign collection he sold recently to Mr. Edward Pearson for the new school at Cloudland, N.J. He had been ailing for some years, but his death, which occurred at the home of his brother-in-law, Mr. E. H. Cole, at Nyack, on Oct. 13, was very sudden. At noon he had a severe hemorrhage, and at half-past two passed away, almost without a struggle. The cause of his death is believed to have been rheumatism of the heart. He was buried at Nyack Cemetery, Oct. 16.

— Mr. John Gilmer Speed has become the editor of *The American Magazine*. Mr. Speed was for several years managing editor of the *New York World*, before it was purchased by its present proprietor. Since then he has spent much time in foreign travel, and has also been a frequent contributor to the magazines and newspaper press. He has written a life of John Keats, and edited his letters and poems. In conducting the magazine, it is Mr. Speed's purpose to make it all that its name implies, — an illustrated monthly, representative of American thought and life. —— E. and F. N. Spon announce as in preparation, 'A Treatise on Masonry Construction,' by Ira O. Baker; 'Metallic Alloys,' by W. T. Brannt; 'Notes in Thermo-dynamics and Steam-Engine Experiments,' by Prof. C. H. Peabody; and 'A Practical Treatise on Modern Printing Machinery,' by F. J. F. Wilson and D. Grey. —— A. & C. Black, Edinburgh, will publish this month the twenty-fourth and concluding volume of the 'Encyclopædia Britannica,' which has been under way nearly ten years. A general index to this encyclopædia is also in press, and may be looked for some time next year. —— Arrangements are being made, it is reported, with the sanction of the German Emperor, for the publication of an English translation of the 'Reminiscences of Ludwig Schneider,' who was for twenty-six years the reader, secretary, and confidential friend of the Emperor William. Schneider's diaries were regularly revised by the Emperor every year, and his book is a work of great interest and importance. He accompanied the Emperor throughout the campaigns of 1866 and 1870–71, and one of the most interesting passages is his Majesty's own account of the battle of Rézonville. —— Much of the genuine value of the *Atlantic* lies in the terse, clean-cut, and vigorous articles on American history by John Fiske, the latest of which is entitled 'The Eve of Independence.' Mr. Fiske's historical articles are worthy of the highest praise. Lillie B. Chace Wyman continues her 'Studies of Factory-Life;' Miss Murfree, her serial story entitled 'The Despot of Broomsedge Cove;' and William Howe Downes, his papers on 'Boston Painters and Paintings.' William Roscoe Thayer con-

tributes an article on 'The Makers of New Italy,' and John Trowbridge writes on 'Economy in College-Work.' —— The issue of *The Youth's Companion* for November contains the article, written expressly for that periodical by Mr. Gladstone, on 'The Future of the English-Speaking Races.' —— *Outing* for November contains, besides other notable features, the commencement of a series of articles on the 'Outdoor Life of the Presidents,' from the pen of John P. Foley; and the 'Progress of Athletism,' by Charles Turner. —— The November *Century* begins the thirty-seventh volume and nineteenth year of the magazine; and the number is made notable by the beginning of several new series, or magazine 'features.' The most important of these is the first instalment of *The Century* 'Gallery of Old Masters,' engraved by T. Cole, and described by W. J. Stillman and by Mr. Cole himself. The engravings in this series were made in the presence of the original pictures themselves. They are actual copies, and unique in the history of art; for such careful copies have never before been made on wood. Another series begun in November is Mr. Cable's 'Strange True Stories of Louisiana.' After a preface by Mr. Cable himself, comes the extraordinary story of 'The Young Aunt with White Hair,' from an old French manuscript. Among the leading contributions to this number are instalments of the 'Life of Lincoln' and of George Kennan's papers on the Siberian exile system. The guilds of the city of London are described by Norman Moore. Other contributions include 'Bird Music: The Loon,' by Simeon Pease Cheney; 'Mammy's Li'l' Boy,' a negro dialect crooning song, by H. S. Edwards, illustrated by E. W. Kemble; 'Memoranda on the Civil War;' Open Letters by George Kennan, Rev. T. T. Munger, Richard Hoffman, and others; etc.

— Dr. John C. Branner, in the first volume of the Proceedings of the Lackawanna Institute of History and Science, gives an interesting sketch of the effects of glaciation in the Lackawanna-Wyoming region, his principal object being to attract special attention to a detailed study of these phenomena. He also publishes a list of localities at which glacial striæ have been observed in that region, for the guidance of those who may take up the work where he was obliged to leave it on being appointed director of the Geological Survey of Arkansas.

— The Boylston medical prize of four hundred and fifty dollars has been awarded by Harvard University to Dr. George H. F. Nuttall of San Francisco, for a dissertation entitled 'A Contribution to the Study of Immunity.'

— The *Journal of Economics* for October opens with a paper by James Bonar on the Austrian economists. Their principal work has been on the theory of value, which they profess to present in an entirely new light; but Mr. Bonar shows that their view, though expressed in new terms, is not so different from that of the English writers as they seem to suppose. Their discussion of 'subjective value' is in his opinion their principal contribution to economics. Another theoretical article is that by Stuart Wood on 'A New View of the Theory of Wages.' The author starts with the fact that in some employments a certain work can be done either by labor or by capital; and from this he deduces the law that in such cases the price paid for a given amount of labor will be equal to the interest on the capital that can be substituted for it. Then the rates of interest and wages thus established will also prevail in all other employments. According to this theory, wages depend on interest; but what interest itself depends on, the author neglects to say. Professor Dunbar's paper on Alexander Hamilton shows that in his sinking-fund scheme, and in establishing the Bank of the United States, Hamilton followed English precedents, though with some variations; but that his plan for establishing the national credit on a firm basis was so comprehensive and so successful as to entitle him to rank as a great financial statesman. The article on 'The Australian Tariff Experiment' is a comparative exhibit of the effects of free trade in New South Wales and of protection in Victoria. The general outcome is to show that manufactures have prospered as well in the free trade colony as in the protected one, while in commerce and in growth of population the former has taken the lead. Wages are essentially the same in both; so that in this case, at least, protection has not raised wages. The acts given in this paper have been published in different forms elsewhere; but, in the present state of our own tariff question, this new presentation of them will attract attention, and doubtless be useful.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Dream Excitation.

THE direct influence of slight sense-stimuli upon the flow and make-up of our dream consciousness is a well-known fact, which can be proved by artificial experiment (see MAURY, *Le Sommeil et les Rêves*, p. 132, etc.), but which it is difficult to confirm under ordinary circumstances, since we seldom waken after a well-marked dream experience in time to catch the stimulus, or without altering the stimulus by movement, etc. On the night of Oct. 22 I had a dream which perfectly fulfilled the conditions of this experiment. I fell asleep about eleven o'clock, and found myself with a companion in a wood, watching a number of wood-cutters at work. After looking at them for some time, one of the workmen drew my attention quite suddenly by giving forth a strange sound, half musical and half speech, by which he seemed to be trying to express something to his neighbor; and the sound came with every blow of his axe in regular rhythm. The sound seemed to me distinctly familiar and yet very strange, and I turned to my friend and said, "What an apology for conversation!" Just as I spoke, I awoke, and the sound of the peculiar tone of a clock down stairs striking twelve broke in upon my consciousness. The four remaining strokes of the clock preserved exactly the rhythm of the wood-chopper's axe; and not only so, but the sense of familiarity which had puzzled me in the dream was relieved with a glow of pleasure as I recognized the sound of the clock.

This experience illustrates also the remarkable swiftness with which new sensations are assimilated to the character of a previous dream consciousness. Before the clock began, the men were simply cutting, without order or distinction. But when the sound broke in, it was at once *accommodated* to the scene by important modifications. One workman is singled out: he begins to ply his axe in the regular time of the clock-beats, and to give forth a sound which preserves in its general character the peculiarities of the real sound. Now, since I experienced in the dream no less than four beats, as the rhythm was perfectly established and clear in my consciousness, and there remained four beats after I awoke, this whole accommodation must have taken place in the interval between the first and the fifth beat (for it was then twelve o'clock). I have since measured the interval between the strokes of the clock, and find it to be two seconds. The whole time from the first to the fifth beat was therefore eight seconds. From this should be taken the time occupied by the dozed state between dreaming and waking, — say, at least one interval of from two to four seconds. There remains a period of four to six seconds as the time of accommodation. This may be called, in a very rough way, the re-action time for a complex case of constructive imagination; for the constructive imagination is nothing more than the free play of images in forms of ideal composition, due to the influx of additions from the sensorium. There is no direct way of measuring this time in the waking state, since the attention interferes with the process.

MARK BALDWIN.

Lake Forest, Ill., Oct. 23.

Chemical Action between Solids.

APROPOS of Messrs. Spring and Hallock's controversy (*Science*, xii. p. 184), I think that the re-actions between silica and the metallic oxides at temperatures far below the melting-point, not only of both components but even of the silicate itself, have generally been regarded as occurring directly between solids. When certain mixtures of lime and silica are strongly heated, though there be not the slightest indication of fusion, yet some chemical action seems to occur, for the silica now separates in the gelatinous state when acted on by hydrochloric acid (PERCY, *Fuel*, p. 46, 1875).

HENRY M. HOWE.

Boston, Oct, 28.

Publications received at Editor's Office, Oct. 22-27.

BALL, W. W. R. A Short Account of the History of Mathematics. London and New York, Macmillan. 464 p. 12°. $2.60.

BENNETT, J. L. Plants of Rhode Island, being an Enumeration of Plants growing without Cultivation in the State of Rhode Island. Providence, Providence Press Co., Pr. 128 p. 8°.

BERGER, F. French Conversations, Idiomatic Expressions, and Proverbs. New York, The Author, 853 Broadway. 32 p. 16°. 25 cents.

CALDERWOOD, H. Handbook of Moral Philosophy. 14th ed. London and New York, Macmillan. 376 p. 12°. $1.50.

CAMERON, J., *ed.* Soaps and Candles. Philadelphia, Blakiston. 306 p. 12°. $2.25.

CHAMBERS-KETCHUM, Annie. Botany. Philadelphia, Lippincott. 192 p. 12°. $1.

COMSTOCK, J. H. An Introduction to Entomology. Part I. Ithaca, N.Y., The Author. 234 p. 8°. $2.

GARDNER, E. C. Town and Country School Buildings. New York and Chicago, E. L. Kellogg & Co. 128 p. 12°.

GRAHAM, R. Chattel Mortgages on Saloon Fixtures in New York City. New York, Church Temp. Soc. 22 p. 8°.

JONES, D. E. Examples in Physics. London and New York, Macmillan. 260 p. 16°. 90 cents.

JORDAN, D. S. A Manual of the Vertebrate Animals of the Northern United States. 5th ed. Chicago, A. C. McClurg & Co. 375 p. 12°. $2.50.

MIDDLETON, A. E. Memory Systems, New and Old. New York, G. S. Fellows & Co. 143 p. 16°. 50 cents.

NEW SOUTH WALES, Annual Report of the Department of Mines, for the Year 1887. Sydney, Government. 216 p. f°.

NEW ZEALAND, Reports on the Mining Industry of. Wellington, Government. 152 p. f°.

NICHOL, J. Francis Bacon: his Life and Philosophy. Part I. Bacon's Life. Philadelphia, Lippincott. 212 p. 16°. $1.25.

NORDHOFF, C. Peninsular California. New York, Harper. 130 p. 8°.

PARKER, W. J. The Human Soul: its Origin and analysis. Nashville, Tenn., Hasslock & Ambrose. 15 p. 12°.

PAYSON, E. The Law of Equivalents in its Relation to Political and Social Ethics. Boston and New York, Houghton, Mifflin, & Co. 306 p. 12°. $2.

PRICE, T. R. The Construction and Types of Shakespeare's Verse, as seen in the Othello (Papers of the N.Y. Shakespeare Society, No. 8.) New York, Shakespeare Soc. 69 p. 16°.

PROCTOR, R. A. Great-Circle Sailing: indicating the Shortest Sea-Routes and describing Maps for finding them in a Few Seconds. London and New York, Longmans, Green, & Co. 16 p. 4°. 1 shilling.

QUICK, R. H. How to train the Memory. (Teachers Manuals. No. 9) New York and Chicago, E. L. Kellogg & Co. 40 p. 16°.

ROHÉ, G. H. Memorial Address delivered before the Faculty and Students of the College of Physicians and Surgeons on the First Anniversary of the Death of Professor A. F. Erich. Baltimore, Thomas & Evans, Pr. 15 p. 8°.

RUTHERFORD, W. G. First Greek Grammar. London and New York, Macmillan. 185 p. 16°. 50 cents.

SAFFORD, T. H. A Discourse read June 25, 1888, to commemorate the Fiftieth Anniversary of the Dedication of the Hopkins Observatory of Williams College. Williamstown, Mass., Williams College. 32 p. 8°.

SCUDDER, H. E. Literature in School. Boston and New York, Houghton, Mifflin, & Co. 60 p. 16°. 15 cents.

SEXTON, S. The Ear and its Diseases, being Practical Contributions to the Study of Otology. Ed by C. J. Colles, M.D. New York, William Wood & Co. 461 p. 8°.

SHAW, A., *ed.* The National Revenues: a Collection of Papers by American Economists. Chicago, McClurg & Co. 245 p. 16°. $1.

SOUTHWICK, A. P. A Quiz Manual of the Theory and Practice of Teaching. New York and Chicago, E. L. Kellogg & Co. 132 p. 16°.

SCIENCE

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SCIENCE

FRIDAY, NOVEMBER 9, 1888.

THE PAST SEASON has been one of unusually successful activity with the United States Fish Commission, a review of whose work is published elsewhere in this issue of *Science*. Probably the most important accomplishment during the year has been the establishment, at Gloucester and Wood's Holl, of stations capable of hatching four hundred million codfish-eggs, and which, with favorable weather, may be expected to put at least one-fourth of that number of cod-fry into the Atlantic Ocean during the present season. The problem of restocking the coast of New England with inshore cod, which has become so scarce except in Ipswich Bay, has been definitely solved. It is only a question of time, and a very short time at that, before codfish can be made to be more plentiful on the coast of New England than they were years ago, and a lost industry restored that will be worth millions of dollars to that section of the country. The only probable causes of delay are bad weather during the hatching-season, and anchor-ice, which kills the small fishes. It is known that only an infinitesimally small proportion of the fry hatched out at the fish-commission stations, and put into the rivers and lakes and the ocean, ever survive to reach maturity. It is only by planting an enormous quantity of the fry that the supply of fish is increased. It is claimed, that, of those artificially propagated, a much larger proportion survive than when the eggs are deposited naturally in the stream. In order to ascertain whether the number of small fishes to survive might not be enormously increased, Commissioner McDonald placed in a pond in Washington, in June, two million shad-fry. Eight hundred thousand of these are still alive, — breathing fishes from three to four inches long each. These will be kept until spring, and then placed in the Potomac. As a rule, they will by that time be able to take care of themselves. The remarkable success of this experiment may cause an entire change in the methods of artificially propagating shad. A new scheme of gathering up the small indigenous fishes hatched in ponds and lakes on the borders of Western and Southern rivers after their annual overflow, and planting them in the rivers, which, in many cases, have been depleted by over-fishing and the destructiveness of the floods, was put into successful operation this year. A hundred thousand fishes were thus rescued from sure death, when, later in the season, these lakes and ponds dry up. On the Pacific coast the steamer 'Albatross' has done the preliminary work of developing the extremely valuable halibut-fishing grounds that lie off the coast of Washington Territory and Vancouver's Island, convenient to the ports of Puget Sound, defined the boundaries of several deep-sea codfishing banks off the coast of Alaska, and will devote the winter to similar work in lower latitudes. The results of her first season's work are expected to be of very great economic value to the Pacific coast. These are but a few of the branches of work accomplished by the United States Fish Commission during the past season, though probably the most important. This commission is the most profitable of all the bureaus of the government, and ought never to lack for money.

ON NOV. 2 the following telegram was sent from Zanzibar: "Couriers from Tabora bring direct news from the Stanley expedition, a portion of which was met at the end of November, 1887, by Arabs trading between Lakes Victoria Nyanza, Mvutan Nzige, and Tabora. These Arabs met Stanley's rear guard at a point west of Mvutan Nzige, south-east of Sanga, just as the expedition was preparing to cross extensive swamps. The Arabs did not see Stanley. The detachment seen consisted of thirty men. They stated that Stanley was two days ahead. The expedition had suffered greatly on the march through a thick forest, where it was impossible to advance more than a mile and a quarter daily. They had also suffered in the marshes, where many had disappeared or died. Forty were drowned in crossing a great river flowing from east to west. One white man had died. Stanley was obliged to fight some tribes that refused to supply him with provisions. The expedition had often halted in the expectation of receiving re-enforcements from the Kongo. The rear guard, at the time met, had only been on the march five days after a halt of three weeks, due to the illness of Stanley and a great part of the escort, who had been attacked with fever. The Arabs estimate the total strength of the expedition, after all losses, at two hundred and fifty men. The health of Stanley was then good. The rear guard, which consisted of natives of Zanzibar, stated that Stanley had decided that he would no longer advance in a north easterly direction, but would strike toward the north, hoping to avoid the swamps. After getting a certain distance north, he intended to take an oblique line to the eastward, and go straight to Wadelai, where it was thought he would arrive fifty days later, — about the middle of January, 1888. The Arabs were of the opinion that the expedition was still strong enough to reach Wadelai." We hesitate to accept this news as authentic, as it corresponds too closely to the views recently expressed in numerous newspapers, particularly regarding Stanley's intention to turn northward. Sanga, which is mentioned in this despatch, was visited by Junker in 1882, and marks the south-eastern limit of our knowledge of this region. The Arabs, who claim to have met part of the expedition, must have penetrated beyond the limits of Unyoro. It will be remembered that on Lake Mvutan Nzige and Muta Nzige no information was obtained by explorers regarding the regions farther west, and that there seems to be little communication in this direction. Therefore the report would imply that the Arabs had recently succeeded in opening this country to their trade. Besides this, their route must have led along Lake Mvutan Nzige, where Emin had re-established, a year since, his influence. Therefore it seems somewhat remarkable that no mention is made of Emin Pacha. Another despatch which was received on Aug. 1 in Zanzibar is undoubtedly an invention. It was stated that two messengers had arrived there who had left the interior about the beginning of April, and who reported that Stanley had not arrived at Wadelai up to that time. The messengers stated that in the month of March Emin Pacha did receive some vague and indecisive news of the explorer, which had filtered through from tribe to tribe, but that the reports were very conflicting. Some declared that Stanley, after losing a number of men and a large portion of his supplies, was hemmed in by hostile tribes between the Mabode country and the Mvutan Nzige, while other rumors were to the effect that he had been attacked by the tribes in the Matongora-Mino district, and after several conflicts had diverted his course in an unknown direction. The wording of this despatch is almost exactly the same as that of another received about fifteen months ago, and therefore it cannot be accepted as genuine.

THE ERUPTION OF KRAKATOA.

THE Krakatoa committee of the Royal Society has made its final report,[1] which forms a large quarto volume, and contains a mass of material of the greatest interest. After the remarkable phenom-

[1] The Eruption of Krakatoa, and Subsequent Phenomena. Ed. by G. J. SYMONS. London, Trübner.

ena following the eruption of Krakatoa on Aug. 27, 1883, became first known, and when the optical phenomena attracted increasing attention of the whole civilized world, the Royal Society of England, on Jan. 17, 1884, passed the following resolution: "*Resolved*, That a committee, to consist of Sir F. Evans, Professor Judd, Mr. Norman Lockyer, Mr. R. H. Scott, General Strachey, and Mr. G. J. Symons, with power to add to their number, be appointed, to collect the various accounts of the volcanic eruption at Krakatoa, and attendant phenomena, in such form as shall best provide for their preservation, and promote their usefulness." A history of the work of the committee is detailed in the preface, its expansion by fusion with a committee of the Royal Meteorological Society and by election of new members, and its method of proceedings. At the end of November, 1884, the discussion of the data collected was commenced, which were divided into five portions, each going to a separate sub-committee, and each giving a separate report, which forms the present volume. Thus the work is divided into five parts: 1. 'On the Volcanic Phenomena of the Eruption, and on the Nature and Distribution of the Ejected Materials,' by Prof. J. W. Judd; 2. 'On the Air-Waves and Sounds caused by the Eruption,' prepared in the Meteorological Office, and presented by Lieut.-Gen. R. Strachey; 3. 'On the Seismic Sea-Waves caused by the Eruption,' by Capt. W. J. L. Wharton; 4. 'On the Unusual Optical Phenomena of the Atmosphere, 1883–86, including Twilight Effects, Coronal Appearances, Sky Haze, Colored Suns, Moons, etc.,' by the Hon. F. A. Rollo Russell and Mr. E. Douglas Archibald; 5. 'Report on the Magnetical and Electrical Phenomena accompanying the Eruption,' by G. M. Whipple.

While the Dutch report by Verbeek deals with the local phenomena, the English committee paid specal attention to the meteorological and other occurrences which took place all over the earth.

The most interesting part of Professor Judd's account is his theory as to the part played by water in causing or aiding eruptions. He believes that the disengagement by heat of volatile substances actually contained in the lava is the primary cause of volcanic activity. He proves that the melting-point of all lavas of Krakatoa of different ages, although of the same chemical composition, vary to a great extent according to the amount of water contained in them, their fusibility being greater when water is present. In this case, on melting, they develop a great amount of gases. "In this way the actual nature of the volcanic manifestations at any particular vent are seen to be determined, not so much by the mineralogical constitution of the lava, as by the circumstance of the quantity of water contained in the magma. Where this is great, the lava will be perfectly liquid, and will be almost wholly thrown out in the form of pumice and dust. On the other hand, lavas containing little water will require a very high temperature for their fusion, and they will be characterized by great viscosity rather than perfect liquidity. It is through the introduction of the sea and other surface waters into rock masses by slow percolation from above, and the consequent formation of new compounds, more readily acted upon by subterranean heat, that I am disposed to regard volcanic phenomena as being brought about. In this we find an explanation of the proximity of volcanoes to great bodies of water, which, it seems to me, is far more in accord with the actual phenomena than the supposition that water finds access to volcanic foci by means of actual open fissures."

Professor Judd shows very clearly that the effect of the inrush of water upon lava is quite different, and, especially in the case of Krakatoa, resulted in the formidable violence of the eruption. When the volcano became so far eviscerated as to give access to the water of the sea, the latter cooled the surface of the magma, and as a result the activity of the volcano diminished. As, however, the disengagement of volatile substances actually contained in this material continued, the formation of this crust would have the same effect as fastening down the safety-valve of a steam-boiler, while the fires below were maintained in full activity. This constant augmentation of tension beneath Krakatoa, in the end gave rise to the tremendous explosions which made the eruption of the volcano so remarkable.

In the second part, General Strachey discusses the remarkable atmospheric oscillations, which, starting from Krakatoa, moved as many as seven times over the earth. Their propagation from the volcano to its antipodes and back is shown on a number of interesting maps. The principal results of the inquiry into the movements of this disturbance are, that it had very nearly the characteristic velocity of sound, ranging from 648 to 726 English miles an hour, and that its mode of propagation by an aerial oscillation of comparatively short duration was also closely analogous to that of sound. Waves travelling with and against the direction of the earth's rotation show differences of velocity of about twenty-eight English miles an hour. This may probably be accounted for by the circumstance that the winds along the paths of this portion of the wave would, on the whole, have been westerly, which would have caused an increase of velocity in the wave moving in the opposite direction; so that the observed difference of twenty-eight miles could be produced by an average westerly current of fourteen miles per hour, which is not unlikely.

The author continues, "There is some appearance of a greater retardation of the wave in passing in a direction opposed to the earth's rotation over the northern European stations as compared with those in the south of Europe, which may possibly be due to the lower temperature of the more northern part of the zone traversed. This difference is not to be traced in the wave moving in the opposite direction, which may be accounted for by the path of the wave, when approaching Europe from the west, having lain for a long distance over the Atlantic, where the differences of temperature between the northern and the southern borders of the zone traversed would have been relatively small.

"The path of the wave that passed over the Canadian and United States stations, and Havana, lies nearly on the meridian drawn through Krakatoa, and must have crossed both the polar circles near the poles. The velocities obtained from these stations are peculiar. The direct wave from Krakatoa, which travelled nearly due north and close to the north pole, and its repetitions after passing round the earth in the same direction, had nearly the same velocities as those observed at the European stations, with an apparent decided retardation in the intervals between the first and third passages, and (but to a less extent) between the third and fifth. The wave that passed through the antipodes before reaching the North American stations went nearly due south close to the south pole; and its velocity on this its first partial passage round the earth was very decidedly reduced; but in its next complete circuit the velocity appears to have been much increased, almost reaching the full rate of the true sound-wave. It is difficult to account for this, but the fact seems to be indisputable. Probably an explanation of this peculiar feature of the phenomena may be found in the conditions of the wind and weather in the southern ocean during the days on which the wave passed over it, which are not known to us."

In the second part of General Strachey's report a list of places is given at which the sounds of the explosions at Krakatoa were heard on the 26th and 27th of August. In all directions the sound was heard at a distance of two thousand miles from the volcano, while south-westward it was even noticed at Rodriguez, very nearly three thousand miles from Krakatoa.

Captain Wharton, in his discussion of the seismic sea-waves caused by the eruption, distinguishes two descriptions of waves, — long ones, with periods of over an hour; and shorter but higher waves, with irregular and much briefer intervals. The greatest disturbance which followed the great explosion of the volcano resulted in waves about fifty feet high in the Strait of Sunda, and caused the vastest destruction. The speed of both classes of waves was about the same, and it is remarkable that it was in all cases less than the depth of water would demand according to theory. To the north and east in the Java Sea the long wave can be traced for 450 miles, but it was at this distance reduced to a very small undulation. To the west, on the other hand, the long wave travelled over great distances, and reached Cape Horn and the shores of Europe. The shorter waves did not extend beyond Ceylon and Mauritius. South-eastward the disturbance did not continue beyond the west coast of Australia; the disturbances noted in New Zealand and in the Pacific evidently being caused by other seismic action, and having no connection whatever with the eruption of Krakatoa.

By far the greater portion of the report is taken up by the dis-

cussion of the unusual optical phenomena of the atmosphere, of which so much has been written. This part is divided into a number of sections, of which the first describes fully the phenomena, and is illustrated by two magnificent chromolithographs. In the long discussion on the proximate cause of the unusual twilight phenomena, F. A. Rollo Russell arrives at the conclusion that a dry haze at a great altitude was their cause. The physical conditions of this phenomenon were the reflection of sunlight on small vitreous surfaces when the intervening air is darkened. He rejects the theory that condensed vapor caused the unusual twilight phenomena, for a number of reasons, principally because spectrum observations and the nature of the corona do not support this view. Besides this, the structure of the haze resembled more that of smoke than that of the highest clouds; and previous effects seen in years of great eruptions, and in places affected by an excess of dust in the air, are very much like those observed in 1883 and the following years. In the same section of the report the colored appearances of sun and moon, which were confined to the tropics, the sky haze, and the corona, are discussed. E. Douglas Archibald, who is the author of the last-mentioned part of the report, describes the corona, which is generally known as 'Bishop's ring,' very thoroughly, and shows that it was probably formed in the haze stratum, and that it was formed by diffraction. Its great size proves that this haze was composed of exceedingly small particles, the diameter of which is computed at .00159 of a millimetre. The occurrence of a corona at a very high altitude, as well as the general absence of accompanying refractive halos, tends to show that the particles through which the diffraction took place were solids and dust rather than ice. Although the corona was associated with the twilight glows and colored suns in being produced by the same elevated haze, it was physically distinct from either, and probably contributed only very slightly to the glows after the sun sank below the horizon.

A long list of dates of the first appearance of optical phenomena — a result of a careful scrutiny of numerous periodicals, logs, and of an extensive correspondence — serves as the basis of a study of the geographical distribution of the various sky phenomena, which proves that it spread rapidly westward, having a velocity of about seventy-six miles an hour.

The researches of E. Douglas Archibald on the height of the glow stratum are of great interest. We will not enter here upon his discussion of Professor Kiessling's theories, as this was the subject of a letter recently published in *Science* (No. 298). The principal results of his inquiry are the following: In the brilliant glows which began in the tropics after the eruption of Krakatoa on Aug. 26 and 27, there is distinct evidence of a primary glow caused by the direct rays of the sun, and of a secondary glow succeeding this, and due to reflection of the primary glow through the same stratum. These primary and secondary glows correspond to the first and second crepuscular spaces of ordinary twilight, the main difference between the secondary of the present series and the ordinary second crepuscular space being that the former was colored, whereas the ordinary second twilight is white, and seen only from high altitudes or in peculiarly favorable circumstances. The glow-causing material appeared suddenly and at about its greatest height at first near Krakatoa, and on its subsequent spread into the extra-tropics it appeared at a lessened altitude. The height of the upper or middle part of the stratum progressively diminished from 121,000 feet in August, to about 64,000 feet in January, 1884. By April, 1884, a considerable portion of the larger reflecting particles had sifted out by gravitation, causing a minimum duration and brilliancy of the secondary glow. As this occurred simultaneously with a maximum development of the corona, it appears probable that a large portion of the finer material remained in suspension at nearly the same height as at first, and that, having become more homogeneous than at first, it was rendered capable of exerting its maximum diffractive power. In the autumn and winter months of 1884 and 1885 the brilliancy of the glows was partially renewed, and thus it is rendered impossible to arrive at any certain deductions regarding the rate of descent of the stratum as a whole. The final effects of the glow-causing material were produced by the prolonged reflection from the lofty stratum of rays partly deprived of their red component by the action of the stratum itself, and to a much larger extent subsequently deprived of their blue components by the ordinary dust and vapor particles of the lower atmosphere. It was therefore mainly an intensification of ordinary twilight phenomena, consequent on the presence, at a lofty altitude, of solid particles not usually existent there.

The whole volume is full of information of the greatest value, and the mass of material collected, as well as its thorough discussion and the clear mode of its treatment, deserves our fullest admiration.

THE UNITED STATES FISH COMMISSION'S WORK DURING THE PAST SEASON.

THE United States Fish Commission has accomplished more, both of practical work and in the line of original investigation looking to practical work in the immediate future, this year than during any previous season of its history. A brief review of its work in both of these departments is given herewith.

An account of the shad-hatching operations of the commission last spring, and a description of the experiment of shipping lobsters to California, and the planting of them in the Pacific Ocean north and south of San Francisco, were given in *Science* (xi. 246, xii. 27) several months ago. In connection with shad-hatching, Commissioner McDonald has been trying this summer a very important and interesting experiment. It is well known that the young shad-fry hatched at the United States Fish Commission stations are not kept until they become little breathing fishes. No means of accommodating them have heretofore existed. It is also known that the mortality among young shad is far greater in the earlier than in the later periods of their existence. The longer they live, the better the chance they have of continuing to live. It is known that only an infinitesimally small percentage of the shad-fry placed in rivers in the spring survive and come to maturity; but so enormous is the number hatched and planted, that those that do escape the scores of enemies they encounter are sufficient to stock abundantly, in a few years, the stream in which they are placed.

This year Colonel McDonald secured on a government reservation in Washington the use of a pond about six acres in extent. In this he caused to be placed, in June, two million shad-fry, and there are now in the pond eight hundred thousand young breathing shad from three to four inches in length. These will all be turned into the Potomac next spring, when they will be much larger than now; and the result will be that the number of fishes put into the river at the opening of the next season will be three times as great as the number taken out last season. The percentages of survivals is probably some thousands of times greater than if the fry had been placed in the river soon after they were hatched. In connection with the work of stocking other streams, and in view of the success that has attended this first experiment, much attention will hereafter be given to the propagation of shad in ponds.

During the past summer a new and very important branch of work has been taken up. When a freshet occurs in the Lower Mississippi River, it inundates a belt of country of an average width of about sixty miles, and the territory along its tributaries is covered with water to an extent varying with the topography of the country and the sizes of the rivers. These floods carry with them, of course, enormous quantities of the indigenous fishes of the rivers; and when the waters recede, ponds and lakes are left in the frequent depressions of the surface. These often actually swarm with fishes and with the millions of fry that have been naturally hatched in them. But later in the season a majority of these ponds and lakes dry up, and not only the mature fishes, but the millions of young ones perish. Colonel McDonald this year sent to these Western and Southern rivers the cars of the Fish Commission, with a sufficient force to seine these ponds and lakes, gather up the small fishes, and to plant them in the rivers where they naturally belong, many of which have been depleted by over-fishing and by the effects of the floods. More than a hundred thousand young fishes were thus planted during the past season; and it is the intention of Commissioner McDonald, in restocking the rivers of the West and South with indigenous fishes, to utilize in the way described nature's great hatcheries, instead of incurring the much greater risk and expense of artificial propagation.

The rivers operated upon during the past season were the Ohio

and Muskingum in Ohio, the Blue River in Indiana, about twenty rivers and ponds in Illinois, the Barren and Green Rivers in Kentucky, and the Current River in Missouri, besides a number of lakes, Geneva Lake in Wisconsin, and the Blue, Beaver, and Alcorn Rivers in Nebraska. The varieties of edible fishes planted in these rivers include all the common kinds, such as spotted cat, crappie, or fresh-water drum, several species of bass, white perch, and pickerel.

On the Pacific coast the propagation of salmon was renewed, and during the season about five million salmon-fry were placed in the Columbia and McCloud Rivers and in the shorter streams on the coasts of California and Oregon.

On the Great Lakes the propagation of whitefish has been continued, but on a far greater scale than ever before.

In former days the inshore cod and halibut fisheries on the coast of New England were exceedingly valuable, as they still are on the Pacific coast. Thousands of men of small means, and owning little boats and comparatively primitive apparatus, earned comfortable livings by fishing for cod in the Gulf of Maine, Massachusetts and Cape Cod Bays, Vineyard Sound, Long Island Sound, and at many other points along the coast. The fishes were taken in abundance and sold fresh, — the most profitable way to the fisherman. But this source of wealth has been largely destroyed by over-fishing; and in few places along the whole coast of New England, outside of Ipswich Bay, are the cod plentiful enough to pay the fishermen for attempting to take them. To catch cod or halibut in large quantities now, one must go to the offshore banks; and this a majority of these inshore fishermen are too poor to do, or they have domestic ties that keep them at home, or they think the risk too great or the labor too severe to be compensated for by the average 'fares.' The halibut were the first to disappear, and the cod and lobsters have also been caught up; so that now all three are very scarce. These inshore cod never migrate to the offshore banks. During a part of the season they remain quite near the shore, and later move out into deeper water, but never to a great distance from the points where they are found during the fishing-season.

In 1878 it was demonstrated by experiments made by the United States Fish Commission that the eggs of the inshore cod could be artificially hatched, and that the small fishes that survived would return to the shore the next year. A majority of the young cod were, however, killed that year by anchor-ice. Several times subsequently small quantities of inshore codfish-eggs were artificially hatched, but last year the hatching of these codfish-eggs was begun on a large scale. The result was entirely satisfactory. Thousands of the young cod that were hatched during the season of 1887 were seen last spring and summer, and there is no longer any doubt that the inshore fisheries of the New England coast may be restored. This will be as important a result (probably more important) as the work which the Fish Commission has accomplished in regard to stocking rivers with shad; and, according to conservative estimates, the increase in the supply of this valuable food-fish, as a result of the work of the commission, is, in actual value, very much greater than the entire cost of the commission, with all its varied work, from the time of its foundation to the present.

Preparations have now been made for the artificial propagation of inshore cod during the present season on an immense scale. The stations have a capacity for handling four hundred million eggs; and, if the season is favorable, about one-fourth of that number will probably be hatched. The principal obstacles are stormy weather and anchor-ice.

In Maine and upon the Hudson River the work of propagating salmon has been prosecuted during the past season.

During the last twelve months, new fish-commission stations have been established or re-opened, as follows: Clackamas station on the Columbia River, and Baird station on the McCloud River, for salmon-work, put into operation again; an extensive station at Duluth for the propagation of whitefish and trout; a large station at Gloucester, Mass., for the hatching of the eggs of inshore cod. The United States Fish Commission is operating, during the present season, the State station at Sandusky, O., in the propagation of whitefish. Congress, during its late session, provided for a large station at Neosho, Mo., for the propagation of trout and the indigenous fishes of the region. This will be completed by the end of the fiscal year, and is expected to benefit Missouri, Arkansas, Kansas, Texas, and western Louisiana.

The most extensive and important work done by the Fish Commission during the past season, in the way of exploration with a view to future practical results, was that accomplished by the steamer 'Albatross' on the Pacific coast. This steamer, which, since she was built five years ago, had been engaged in work on the Atlantic coast, started around the Horn after the close of last season. She arrived in San Francisco late in the spring, and, July 4, sailed for the Alaskan fishing-grounds. It has been known that the sea-fisheries of the Pacific coast are very extensive and very rich, but they are practically undeveloped except in the vicinity of San Francisco. The purpose of the commissioner in sending the 'Albatross' to the Pacific Ocean was, by a series of careful surveys, to ascertain the locations of the sea-fishing grounds of all kinds, their extent, character, productiveness, their nearness to market, the kinds of bait that might be used, the methods of obtaining it and its abundance, and, in short, to develop the sea-fisheries of the Pacific coast.

Important banks are distributed along the coasts of Washington Territory and Vancouver's Island, at points easily accessible from the ports in Puget Sound. The fishes upon them are very abundant. They swarm with halibut, and also furnish cod in abundance. It was on these grounds that the Gloucester fishing-vessel, 'Mollie Adams,' owned by Capt. Solomon Jacobs, did her successful halibut-fishing during the last summer. She kept her halibut fresh, and shipped it in that condition to the New York and Boston markets, where, in no way inferior to that landed at Gloucester, it was sold at eight cents per pound, while the price of Eastern halibut was twelve cents a pound.

It must not be inferred from this that Pacific coast halibut can compete successfully in New York and Boston with that caught on the Grand Banks. In the first place, the price at which the Eastern halibut was sold was not the natural one, but had been fixed arbitrarily by a 'trust.' Yet the Pacific coast fishermen have some very important advantages. Three or four trips can be made there to one to the great banks of the Eastern coast. These Pacific coast fisheries are also conveniently near ports of shipment. Then Captain Jacobs secured unusually low rates of freight; and, even if he had made no money, he would undoubtedly have sent his fresh halibut East in a spirit of bravado, and to show those people who had laughed at him for taking the 'Mollie Adams' to the Pacific Ocean that he didn't go on so much of a fool's errand, after all.

The permanent markets for fresh halibut caught on the Pacific coast will be San Francisco, and other cities and towns of California that are rapidly growing into importance; the great mountain cities of Salt Lake City, Denver, etc.; and all the Mississippi valley as far east as Chicago, and extending north and south from Duluth to New Orleans. In all this vast territory the reduced expense of catching halibut will enable the Pacific coast fishermen to compete successfully with those who land their fresh halibut at Gloucester.

In Alaska the fishing-banks correspond in their extent, character, kinds, and abundance of fish, with the great offshore fishing-banks of eastern North America. They are inhabited by the same species of cod and halibut that occur on the east coast; and, although the general positions of these Alaskan banks has been known for some years, they have never been surveyed, and the few fishermen who resort to them find the rich spots by trial, and return to them from time to time. The most important of these banks are situated just off the coast from Unalaska to some distance east of Kadiak Island, — an extent of from six hundred to seven hundred nautical miles: that is to say, that, throughout the region whose boundaries have been given approximately, the fishing-banks are as well defined as those on the Atlantic coast; but good fishing occurs both to the north and south throughout the Alaskan coast, while on the north the cod-fishery is limited only by ice.

These banks are a very valuable and important possession. Great quantities of cod are now to be found there, and an industry can be built up that may be made very profitable to the Pacific seaports. Of course, the cod caught on these banks will be salted, and the markets for them will be almost unlimited. They will comprise, besides our own country, the western parts of Mexico,

Central and South America, Japan, China, Australia; in short, the entire populations who live upon or near the Pacific and Indian Oceans.

It is the mission of the 'Albatross' to explore all the fishing-grounds on the Pacific coast. It is expected that she will remain at work the whole year, except during periods occupied in refitting and repairs, and that three or four years will be spent in completing the work. She will spend the summer in the north, working southward as winter approaches. Some of her winter work will be done on the coast of southern California.

The 'Albatross' returned to San Francisco Oct. 21, from her first cruise to the north. She had spent about two and one-half months upon the Alaskan fishing-grounds, and one month in the region off Cape Flattery. A very careful series of soundings was made of the grounds visited; and these, when plotted on charts and represented graphically, will give the contour of a very large fishing-area, to which the attention of fishermen will be called. In addition to this, the regular observations were made to determine the temperatures and densities of the water, the relative abundance of edible fishes on different parts of the banks, the character of the bottom, etc. All kinds of collecting and fishing appliances were constantly and successfully used; and an extensive collection of specimens was secured, which will be studied in the laboratories in Washington, in order to determine the principal natural features of the fishing-grounds. Lieut.-Commander Z. L. Tanner, U.S.N., is in charge of the expedition, having commanded the 'Albatross' ever since her construction in 1883. He has been in active service with the Fish Commission about nine years. Mr. C. H. Townsend is the naturalist, and Mr. A. B. Alexander the fishery expert, of the expedition.

The experimental station at Wood's Holl was kept open during the summer, as usual, from early in July to October. The commissioner himself was present there during most of the time with Prof. John A. Ryder, in charge of the scientific work. From twelve to fifteen volunteer naturalists, including Prof. W. K. Brooks of Johns Hopkins University, were at work at the Wood's Holl station during most of the time. The steamer 'Albatross' having gone to the Pacific coast, and regular explorations on the offshore fishing-banks being therefore suspended, the work of the season consisted mainly in a study of embryology with regard to its bearing upon the fish-cultural branch of the Fish Commission's work. Many studies were also made of fishes and their habits in later stages of development. A quantity of English soles had been brought to this country last spring, and had been kept in a compartment of the laboratory at Wood's Holl. They were planted in Vineyard Sound in October.

The steamer 'Fish Hawk' was employed for about two months in examining the oyster-beds of Providence River, Narragansett Bay, and Long Island Sound near New Haven, with especial reference to the depredations of the star-fish and drill, which are estimated to destroy several hundred thousand dollars' worth of oysters every year. The operations were mainly confined to studies of the temperatures and densities of the water on the oyster-beds upon which these pests thrive, and of the inhabitants of the bottom, with a view of ascertaining the conditions of their existence. It is an interesting fact that the star-fish cannot live in fresh water, nor in water that does not contain a considerable quantity of salt. For this reason, no star-fishes infest the oyster-beds of Chesapeake Bay.

In the early spring of 1886 one of the greatest freshets ever known occurred in Rhode Island. Several inches of snow was on the ground, and beneath this a thick sheet of solid ice. The rain descended as though the flood had come again, carried off the snow, and then, instead of being partially absorbed by the ground, the water all ran down into the streams, converting every one of them into resistless torrents, before which neither dwellings, nor factories, nor bridges, nor railroad-embankments could stand. This immense volume of water all finally found its way into Providence River and Narragansett Bay, and it freshened the water to such an extent that all of the star-fishes perished. In 1887 there were plenty of little star-fishes, but they were too small to do any harm; but this year they are about as destructive as usual.

This examination was not carried as far as was desired, on account of a lack of funds. The people of Connecticut and Rhode Island, interested in the oyster-fisheries, were very anxious to have a thorough investigation made, and Senator Platt introduced a bill to pay the expenses of it. The bill was not passed, and the expedition last summer was paid for out of the regular funds of the Fish Commission. The investigation will be resumed next summer. No practical method of exterminating the star-fish pest has yet been suggested, except the one now practised of dredging them up, which is enormously expensive.

Among the most interesting and important divisions of the scientific work of the Fish Commission during the past season has been the exploration of the interior rivers and lakes of the country for the purpose of ascertaining what indigenous fishes they contain, and obtaining a knowledge of their physical characteristics. Indeed, this work had a twofold object. Besides that already explained, it was desirable to determine the adaptability of these rivers and lakes to the introduction of new fishes of economic value. Illustrative of the importance of this branch of the work, it may be said that requests are frequently received at the Fish Commission office that a certain river or lake be stocked with a particular kind of fish. It cannot be decided whether it will be safe to introduce the fish indicated until it is known what the present inhabitants of the stream or lake are, and whether its physical characteristics are favorable or not. It is useless, of course, to put young and tame fishes into water already inhabited by wild, fierce, predaceous fishes.

The greater part of this work has been conducted under the direction of Pres. David S. Jordan, of the University of Indiana, and one of the most distinguished ichthyologists in the country. His zeal and that of his assistants was not dampened by the fact that they were volunteers, serving without compensation beyond their actual expenses. There are scores of college professors and students advanced in science, who are ambitious to spend the months of their summer vacation in the field, making original investigations. To a majority of such the saving of their expenses is a matter of considerable importance, while the Fish Commission secures the services of men whom it could not afford to hire. The attractiveness of the scientific work of the government, on account of the superior advantages which it offers to those who desire to become specialists, is shown by the eagerness with which positions to which very small salaries are attached, in the United States Geological Survey, are sought, and also by the fact that positions in the National Museum are sought by hundreds of college graduates who are willing to work for salaries that are barely sufficient to pay their board.

President Jordan spent the entire summer in the field with his parties, personally devoting himself mainly to the rivers of Virginia, eastern Tennessee, North Carolina, and parts of South Carolina and Indiana. In North Carolina he found a virgin field of exploration in which he had had no predecessor, and a very interesting one it proved to be. Prof. C. H. Gilbert and Dr. J. A. Henshall of Cincinnati carried on a similar kind of work on the Ohio and other rivers of the Ohio valley, and Mr. C. H. Bollman of Indiana was detailed to accompany the party of Michigan explorers sent out by the Fish Commission of that State. Collections and information of the same kind are expected from Illinois, where the naturalists employed by the State were greatly aided by the use of the fish-commission cars, and in return agreed to give to the latter the results of their observations. The relations between the United States Fish Commission and the various State commissions are very cordial, and they are in many ways helpful to each other.

The schooner 'Grampus' went to the early-mackerel fishing-grounds in the spring for the purpose of observing the arrival of the first shoals of mackerel, and watching their movements as they went north along the coast, and especially the physical changes of the water accompanying those movements. Very important results were obtained. In a general way it may be said that the late arrival of the mackerel last spring was coincident with the lateness in the season, that the temperature of the water remained low, and that the mackerel-food obtained by the use of the towing-net at the surface was less abundant than usual. Observations of the habits of the mackerel were made by the 'Grampus' at intervals throughout the season and as late as the middle of October. These extended from the coast of Maine to Cape Hatteras.

For many years the temperatures of the waters have been recorded by employees of the Lighthouse Board and the Signal Service

at prominent points along both the Atlantic and Pacific coasts, and on the principal rivers and the Great Lakes. The results of these observations are now being plotted graphically upon charts by the Fish Commission, and will be published in an early report. It is expected that they will prove of great importance in explaining the distribution and movements of the fishes.

Altogether the result of the Fish Commission's work has been very satisfactory. Much of the scientific study and digestion of material collected during the summer, of course, still remains to be done, and this will be pushed forward in Washington during the months when, as a rule, field-work is impracticable.

MENTAL SCIENCE.

Notes on Hypnotism.

The Paris and Nancy Schools of Hypnotism. — Dr. Bernheim, the leader of the Nancy school, whose classic work we are soon to have in English, contributes to the *Revue de l'Hypnotisme*, May, 1888, a platform of beliefs. These can be summarized as follows: 1. They do not obtain Charcot's three phases— lethargy, catalepsy, and somnambulism — by any physical manipulation; nor do they find, as Charcot claims, that opening the eyes or rubbing the vertex will cause the patient to pass from one of these stages to another. They do not get the phenomena of *transfert* (of an affection of one side of the body passing to the other) nor the localization of function by pressing different portions of the cranium, nor any purely physiological result. On the other hand, they easily get all these results by a slight suggestion. If the subject has heard of or witnessed the expected results, it is sufficient. Again: the unconsciousness of lethargy is apparent only, the subject being open to suggestions at any stage. 2. *In hysteria magna* the hypnotic phenomena are the same as in normal subjects, the three stages, etc., being equally illusory. 3. Hysterical subjects are not good for the study of hypnotism. They introduce neurotic and other foreign symptoms, and vitiate the purity of the results. 4. The hypnotic state is not a neurotic one. The phenomena are natural, are of a psychological origin, and can be developed from natural sleep. 5. Neurotic patients are not more ready subjects than others, the wards of hospitals representing all types of diseases, furnishing an equal number of good subjects. 6. Not all subjects are purely automata played upon by the operator: more or less resistance is frequent, and the individuality partially remains. 7. All methods of hypnotization depend upon suggestion. Physical methods, especially hypnogenetic zones, do not exist except as the results of suggestion. 8. Suggestion is the key to *all* the phenomena, and careful study with new subjects will prove it so. Moreover, the large percentage (eighty) of subjects among normal persons found at Nancy is not due to a mental contagion, but to a skill in applying the suggestion. This position is rapidly gaining adherence above that of Charcot and the Paris school, which it opposes on all the above points.

A New Hypnotic Phenomenon. — M. Liegois contributes to the August number of the same periodical an article describing a new hypnotic phenomenon, in the field of a 'negative hallucination.' This term describes a state in which the suggestion that a certain person, a certain object in the field of vision, remains unseen, has been obeyed. The state is explained as an annihilation of the perception as it reaches consciousness. The impression is received, but ignored. Having a third party to suggest to one of his subjects that he will be invisible to her, it is found that she does not hear him, see him, or even feel the prick of a pin when he holds the pin, re-acting normally to all other persons. If, however, M. Liegois calls out impersonally, "Camille feels thirsty, Camille will drink a glass of water," she hears and obeys the command; if similarly told to stand at his side, she does so; and so on for every sense. While she does not hear him, she none the less really can hear him. There is a sort of dual personality, one half of which obeys the negative suggestion, while the other is automatically regulated, and obeys any suggestion not directly in conflict with a previous one. The further development of this study promises interesting results.

Hygienic Aspects of Hypnotism. — Upon the hygienic side we find the discussion of the prohibition of public hypnotic performances. The Academy of Medicine of Belgium held a long discussion upon the question, and finally voted to recommend a law abolishing it. The chief advocate in favor of the exhibitions was M. Delboeuf. Belgium thus follows the action of Austria, Italy, Denmark, Germany, and most of the Swiss cantons. The people have been strongly impressed with the dangers of an unskilled use of hypnotism, and a healthy sentiment to have it restricted to experts prevails. At the last session of the French Association for the Advancement of Science, M. Berillon introduced a similar measure, and it was voted as the sentiment of the section of hygiene and public medicine that all public exhibitions of hypnotism should be legally prohibited in France.

Miscellaneous. — Considerable space is taken up in the same periodical with the discussion of phenomena whose genuineness is not recognized, particularly with Dr. Luy's experiments upon the action of drugs at a distance. A committee of the Academy of Medicine was appointed to examine the correctness of Dr. Luy's conclusions, and they find unconscious suggestion to be at the basis of it all. When the contents of the vials containing the drugs were unknown to those present, the subject also failed to be appropriately affected by them. So, again, these pretended mysteries fall to the ground, and exemplify the pitfalls of the subject as well as the uncritical nature of methods often adopted by eminent scientists. Mention should also be made of the fact that the Church has recently entered into relations with hypnotism by a letter from the Bishop of Madrid, warning his brethren against the evils of the new movement, and placing it in line with the forbidden treatment of miracles.

Abnormal Sense-Perceptions.

Sound-Blindness. — Recent observations have emphasized the fact that many persons are defective in the distinctness of their perceptions, while others form peculiar links between perceptions of different senses. An illustration of the former is what has been rather falsely termed 'sound-blindness.' This condition refers to the defective hearing of sounds; so that, in the same way as the color-blind fail to distinguish between to us utterly distinct impressions, the sound-blind fail to make distinctions perfectly evident to ordinary ears. A Boston lady, Sara E. Wiltse, has recently tested the powers of Boston school-children in this direction (*American Journal of Psychology*, No. 4). Standing on the teacher's platform, she repeated the following words as distinctly as possible to 259 boys of the Latin School, aged from twelve to twenty years: 'ultramarine,' 'altruistic,' 'frustrate,' 'ultimatum,' 'ululate,' 'Alcibiades,' 'unaugmented.' The words were repeated as often as required, some as often as five times, and ample time was given for the writing of the words. 84 of the boys made mistakes in the vowel-sounds, such as 'ultruistic,' 'frostrate,' 'altimatum,' 'elulate,' 'olulate,' 'alulate,' 'unolmented.' That these 84 were really defective, was shown by the further test, in which the following words were read to them but once; viz., 'fan,' 'log,' 'long,' 'pen,' 'dog,' 'pod,' 'land,' 'few,' 'cat:' for only 4 of the 84 spelled these monosyllables correctly. For 'fan,' there appeared 'than,' 'thank,' 'fanned,' 'clam,' 'thang,' and 'fam;' for 'log,' 'glove,' 'clog,' 'lug,' 'love,' 'land,' 'long,' 'knob;' for 'long,' 'lung,' 'lown,' 'lone,' 'lawn,' 'land,' 'log,' 'loud,' 'lamp;' for 'pen,' 'penned,' 'pan,' 'paint,' 'hen,' 'ten;' for 'dog,' 'dove,' 'dug,' 'dot;' for 'pod,' 'hour,' 'heart,' 'hog,' 'hod,' 'hard,' 'fod,' 'thod,' 'fog,' 'bog,' 'pug,' 'part,' 'plot,' 'pard,' 'long,' 'bog;' for 'land,' 'lamb,' 'lend,' 'lamp,' 'lambed,' 'blend,' 'hen,' 'can;' for 'few,' 'frew,' 'fuse,' 'pew,' 'pen.' 'Cat' was correctly understood in every case. Of the 80, only 2 were found to be hard of hearing, suggesting that the others were more or less 'sound-blind.' So, again, of 223 boys of the English High School at Boston, 105 misspelled one or more of the polysyllables. In the Comins Grammar School, where the pupils were between the ages of eight and fourteen, only 34 of the 530 spelled all the monosyllables correctly. These pupils were tested under good conditions, and five were found to be deaf to the sound of a tuning-fork, though the teacher was unaware of the defect. For 'fan,' 7 different words and 2 blanks were given (a blank indicating an entire failure to understand the word), the total number of mishearings being 17; for 'log,' 17 different words and 10 blanks, involving 86 mishearings, the word being understood as 'love' 65 times; for 'long,' 14 words and 11 blanks, with 22 errors; for 'pen,' 18 words and 12 blanks, with 135 errors, of which 48 made the word 'hen,'

and 47 'pan;' for 'dog,' 6 words and 1 blank, with 10 errors; for 'pod,' 51 words and 64 blanks, with 270 errors, of which 'hog' is responsible for 85, 'hod' for 36, 'pog' for 26, 'hard' for 25; for 'land,' 14 words and 12 blanks, with 63 errors, the word being written 'lamb' 42 times; for 'few,' 11 words and 10 blanks, with 15 errors; for 'cat,' 5 words, no blanks, and 5 errors. Of course, these errors may be due to defects elsewhere than in the power of sound-discrimination, e.g., in the power of translating auditory into visual symbols; but the variety and nature of the errors are certainly interesting. If we classify the nature of the confusions, we find that in the vowel-sounds, *a*, as in 'fan' and 'cat,' is most apt to be heard as *a* long 8 of 16 times; that the *e* of 'pen' is heard as a short *a* 69 of 84 times; the *o* of 'dog,' 'log,' 'long,' 'pod,' as a short *u* 83 of 132 times; while the *ew* of 'few' is about equally often regarded as various other sounds. With regard to consonants, *d*, as in 'dog,' 'pod,' becomes hard *g* 132 of 199 times; the *g* of 'dog' becomes *v* 67 of 82 times; the *p* of 'pen,' etc., becomes *h* 240 of 278 times; the *n* of 'pen,' etc., becomes *m* 56 of 78 times; the *ng* of 'long' becomes *n* 7 of 15 times; while *h*, *t*, and hard *c* have no sounds with which they are specially confused. These facts should be of some importance to philologists, and will perhaps agree with the laws of language and dialect transformations.

Color and Taste. — The peculiar association of a color with a sound by which a certain sound will at once vividly arouse a definite color, is quite normal, and has of recent years been frequently described. The association of color with smells is a much rarer phenomenon, and of color with tastes perhaps rarer still. Dr. Féré gives an account of a woman, who, after taking vinegar, saw every thing red for a few minutes, and then every thing as bright green for more than an hour. Dr. Féré explains this as due to a similarity in the subsidiary emotional effects accompanying the sensation.

HEALTH MATTERS.

Use of Tobacco.

C. W. LYMAN, in a communication to the *New York Medical Journal*, discusses in a very entertaining way, tobacco, its use and abuse. Tobacco, he says, contains an acrid, dark-brown oil, an alkaloid, nicotine, and another substance called nicotianine, in which exist its odorous and volatile principles. This description of the active principles of tobacco is of importance to smokers; for, when tobacco is burned, a new set of substances is produced, some of which are less harmful than the nicotine, and are more agreeable in effect, and much of the acrid oil — a substance quite as irritating and poisonous as nicotine — is carried off. These fire-produced substances are called, from their origin, the 'pyridine series.' By great heat the more aromatic and less harmful members of the series are produced, but the more poisonous compounds are generated by the slow combustion of damp tobacco. This oil which is liberated by combustion is bad both in flavor and in effect, and it is better, even for the immediate pleasure of the smoker, that it should be excluded altogether from his mouth and air-passages.

Smoking in a stub of a pipe is particularly injurious, for the reason that in it the oil is stored in a condensed form, and the smoke is therefore highly charged with the oil. Sucking or chewing the stub of a cigar that one is smoking is a serious mistake, because the nicotine in the unburned tobacco dissolves freely in the saliva, and is absorbed. 'Chewing' is on this account the most injurious form of the tobacco habit, and the use of a cigar-holder is an improvement on the custom of holding the cigar between the teeth. Cigarettes are responsible for a great amount of mischief, not because the smoke from the paper has any particularly evil effect, but because smokers — and they are often boys or very young men — are apt to use them continuously or at frequent intervals, believing that their power for evil is insignificant. Thus the nerves are under the constant influence of the drug, and much injury to the system results. Moreover, the cigarette-smoker uses a very considerable amount of tobacco during the course of a day. 'Dipping' and 'snuffing' are semi-barbarities which need not be discussed. Not much effect is obtained from the use of the drug in these varieties of the habit.

Nicotine is one of the most powerful of the 'nerve-poisons' known. Its virulence is compared to that of prussic acid. If birds be made to inhale its vapor in amounts too small to be measured, they are almost instantly killed. It seems to destroy life, not by attacking a few, but all of the functions essential to it, beginning at the centre, the heart. A significant indication of this is that there is no substance known which can counteract its effects: the system either succumbs or survives. Its depressing action on the heart is by far the most noticeable and noteworthy symptom of nicotine-poisoning. The frequent existence of what is known as 'smoker's heart' in men whose health is in no other respect disturbed is due to this fact.

Those who can use tobacco without immediate injury will have all the pleasant effects reversed, and will suffer from the symptoms of poisoning if they exceed the limits of tolerance. These symptoms are: 1. The heart's action becomes more rapid when tobacco is used; 2. Palpitation, pain, or unusual sensations in the heart; 3. There is no appetite in the morning, the tongue is coated, delicate flavors are not appreciated, and acid dyspepsia occurs after eating; 4. Soreness of the mouth and throat, or nasal catarrh, appears, and becomes very troublesome; 5. The eyesight becomes poor, but improves when the habit is abandoned; 6. A desire, often a craving, for liquor or some other stimulant, is experienced.

In an experimental observation of thirty-eight boys of all classes of society, and of average health, who had been using tobacco for periods ranging from two months to two years, twenty-seven showed severe injury to the constitution and insufficient growth; thirty-two showed the existence of irregularity of the heart's action, disordered stomachs, cough, and a craving for alcohol; thirteen had intermittency of the pulse; and one had consumption. After they had abandoned the use of tobacco, within six months' time one-half were free from all their former symptoms, and the remainder had recovered by the end of the year.

A great majority of men go far beyond what may be called the temperate use of tobacco, and evidences of injury are easily found. It is only necessary to have some record of what the general health was previous to the taking-up of the habit, and to have observation cover a long enough time. The history of tobacco in the island of New Zealand furnishes a quite suggestive illustration for our purpose, and one on a large scale. When Europeans first visited New Zealand, they found in the native Maoris the most finely developed and powerful men of any of the tribes inhabiting the islands of the Pacific. Since the introduction of tobacco, for which the Maoris developed a passionate liking, they have from this cause alone, it is said, become decimated in numbers, and at the same time reduced in stature and in physical well-being so as to be an altogether inferior type of men.

ELECTRICAL SCIENCE.

Some New Tests of Secondary Batteries.

IN the last two years the improvements in storage-batteries have been such as to indicate the near approach of the time when they can be economically used for street-car work. Indeed, it is now a question whether, under favorable conditions, they cannot advantageously replace horses; and the result of the experiments on the Fourth Avenue Road in New York, where ten storage-cars will soon be regularly operated, will be awaited with interest.

Dr. A. von Waltenhofen, in the *Centralblatt für Electrotechnik*, gives the results of some interesting experiments on the Farbaky-Schenck accumulators that have a direct bearing on the subject of electric traction. But before giving the results, it is well to call to mind the points in which the present storage-cells are lacking. The principal point is in the small discharge-rate, necessitating a large number of cells being carried by each car (from 3,200 to 4,500 pounds), a corresponding increase in the weight of the car itself to give the strength necessary to sustain this increased weight, a larger outlay for battery and a corresponding depreciation, a greater power to move the greater weight, and the necessity of re-laying much of the track now in use with heavier rails and a better road-bed. For instance: the weight of an ordinary 16-foot car is from 6,000 to 7,000 pounds. Equipped with motors and storage-battery, the weight is about 13,000 pounds. A car equipped with this weight of battery can be run for from 45 to 60 miles, depending on the conditions of the track and the type of equipment.

Now, what is wanted is a cell with, say, the same storage-capacity and weight, — even with the same rate of depreciation, — but which has a normal rate of discharge and charge of four or five times that of the present type. We could then use from 1,000 to 1,500 pounds of battery on a car, — enough to make one or two round trips, — reduce the total weight of the car to 9,000 pounds, decrease the investment and cost of renewal three or four times, and allow the present car bodies and tracks to be used without any considerable alteration. Under these circumstances (and there is no doubt the conditions will be sooner or later attained), street-car traction by secondary batteries would be an assured and immediate success for any ordinary condition of grade.

Dr. von Waltenhofen's experiments are of interest in this connection, because of the very rapid discharges to which he subjected the Farbaky-Schenck cell, with apparently excellent results as to efficiency and freedom from harmful effects. The cell in question had seven positive and six negative plates, weighing 47 pounds, the total weight of the cell being about 60 pounds. It was constructed with a view to discharging it at 100 ampères, — five times the normal rate. The plates of this type of storage-cell have been described in this journal. They are of a modified 'grid' form, the holes being filled with a mixture of red lead and coke, or other porous material, moistened with sulphuric acid.

The cell was first completely charged, and then discharged at a rate of 100 ampères, until the potential difference at the terminals fell from 1.87 to 1.78 volts. The capacity was 166 ampère hours. Then the cell was charged at 20 ampères, and discharged at 100 ampères as before, but only 100 ampère hours were put in. 88 ampère hours were returned, giving an efficiency in ampère hours of 88 per cent. In total energy the efficiency was 77 per cent. It is evident, however, that these figures are much higher than would be obtained if the cell was fully charged. In another experiment the discharge-rate was increased to 200 ampères, the cell was charged with 200 ampère hours, and the output was about 130 ampère hours, — a current efficiency of 65 per cent, with a total efficiency of from 45 to 50 per cent. It is stated that neither of these discharges injured the cell in any way. A current of 300 ampères was then tried, and the cell kept up its potential difference reasonably well for about fifteen minutes. As to the effect the author says, "Whether this great over-exertion has been injurious to the accumulator, Messrs. Farbaky and Schenck do not state; but our experiments have shown that the cell can be discharged without injury at 200 ampères."

The author compares the performance of several types of cells, from which we get the following data: —

Farbaky and Schenck. — Capacity per pound of plate, 3.5 ampère hours; discharge-rate per pound, 2.1 ampères; total efficiency, 77 per cent (?).

Reckenzaun. — Capacity per pound of plate, 4.1 ampère hours; discharge-rate per pound, .37 of an ampère; total efficiency, 81 per cent.

Julien. — Capacity per pound of plate, 4.2 ampère hours; discharge-rate per pound, .42 of an ampère; total efficiency, 83.5 per cent.

Tudor (*at a practical discharge-rate*). — Capacity per pound of plate, 1.3 ampère hours; discharge-rate per pound, .33 of an ampère; total efficiency, 68.6 per cent.

These figures of Dr. von Waltenhofen for the Farbaky-Schenck accumulator mark an advance, and an advance that is in the right direction; but it is greatly to be regretted that the most important fact that is brought forward, namely, that the cells are not injured by such high discharge-rates, rests on a bare assertion, and no figures are given to show that a number of such discharges extending over a considerable period have been attempted.

NEW METHOD OF PRODUCING ELECTRIC CURRENTS. — C. Braun, in the *Berichte der Berliner Akademie*, describes a new method of producing electric currents. A wire of nickel is twisted into a spiral, and the two ends are connected with the terminals of a sensitive galvanometer. When the spiral is suddenly pulled out, there is a deflection of the galvanometer; and, when it is compressed, there is a deflection in the opposite direction. The direction of the current in a connected wire is determined by the direction of the twist as looked at from the end to which the wire is connected. It is stated that the effects cannot be accounted for by induction. A heating or cooling of the wire as a whole produces the same effects. If the wire is annealed, it loses its power of giving a current, but regains it again on being stretched. The effect is not large enough in diamagnetic bodies to be observed with any certainty. It seems to exist in iron and steel, but other effects make the observations difficult. If these effects exist at all, and are not due to induction, they are probably caused by the different strains on the outside and inside of a spire of the wire. It is stated that if the wire be magnetized the effect is greatly augmented.

SOME CURIOUS INCANDESCENT LAMP PHENOMENA.—The *Electrical World* publishes a letter from F. J. Crouch describing some curious effects obtained with incandescent lamps, both of whose terminals were joined to the circuit of an alternating-current dynamo. The circuit of the dynamo is made through a resistance of about 2,000 ohms (the electro-motive force is not stated). To the leads on one side of the resistance are attached both terminals of some Bernstein incandescent lamps, whose bulbs are immersed in tumblers of salt water. From the other side of the resistance, and therefore at a potential differing greatly from that of the lamps, wires are brought to the tumblers and dipped in the water. "Now, when the dynamo is started, the light appears, and the light-waves pass through the glass." The light is described as "similar to that of the glow-worm or firefly. With three Bernstein lamps, I obtained a beautiful moonlight effect, sufficient to read by in a large room." Another interesting phenomenon has been brought out in a series of letters to the same paper. It is found that incandescent lamps in the vicinity of belts or apparatus giving considerable statical discharges have a very short life. The writer has tried a few experiments to verify this. On holding near a Weston lamp (110 volts) the end of a wire connected with a Holtz machine, if the lamp be burning and the machine is turned rapidly, the filament will break in from one to five minutes. In the first lamp experimented on there was a very marked vibration of the filament, being more violent when the negative pole of the Holtz machine was presented. This lasted for perhaps a minute, when the filament broke. Some other lamps were experimented on in which there was no vibration of the filament that could be noticed; still they broke in a short time. The effect is of some practical importance in paper and other mills, and the life of the lamps can be greatly increased by putting over the bulb a wire netting connected with the earth. If the net be made of polished wire, — German silver, for instance, — there will be little or no loss of light.

BOOK-REVIEWS.

Literature in School. By HORACE E. SCUDDER. Boston and New York, Houghton, Mifflin, & Co. 16°. 15 cents.

OF the many reforms now being urged in school matters, one of the most commendable, and one which appeals to the best sense of the community, is that which urges the replacing of the literary mess now offered to the child in the usual school-reader by works of literature which have won for themselves a place. In this movement Mr. Horace E. Scudder of Cambridge has taken and is taking a leading part. Not only has he written forcibly and well on the subject, but he has himself prepared various editions of standard works fit for use in the school-room. In the present pamphlet Mr. Scudder prints his address on the subject of 'Literature in Common-School Education,' read before the National Education Association at its meeting in San Francisco in July last, and his two papers on 'Nursery Classics' and 'American Classics' respectively, which have recently appeared in the *Atlantic Monthly*. Mr. Scudder points out that literature has a field and an office of its own, and, unless it is recognized in the school, the place which it should take must remain unfilled. Literature gives expression to the spiritual and non-material wants of man, and must be brought into the foreground to counterbalance the tyranny of materialism, which bids fair, unless checked, to increase year by year. Mr. Scudder does not mean by the reading of literature in school the critical study of great authors. To urge that, would be to place a weapon in the hands of his opponents; but he says (p. 31), "The place, then, of literature in our common-school education, is in

spiritualizing life, letting light into the mind, inspiring and feeding the higher forces of human nature. In this view, the reading-book becomes vastly more than a mere drill-book in elocution; and it becomes of the greatest consequence that it should be rigorously shut up to the best, and not made the idle vehicle of the second best. It must never be forgotten that the days of a child's life are precious: it has no choice within the walls of the school-room. In its hours for reading it must take what we give it. Be sure that the standard which we set in our school reading-books will inevitably affect its choice of reading out of school; that the conceptions which it forms of literature and the ideal life will be noble or ignoble, according as we use our opportunities. It is for us to say whether the American child shall be brought up to have its rightful share in the great inheritance of America."

In the second essay, after pointing out the desirability of teaching nursery classics in school, the author says (p. 41), "The drawback to the use of these nursery classics in the school-room has been in the absence of versions which are intelligible to children of the proper age, reading by themselves. The makers of the graded reading-books have expended all their ingenuity in *grading* the ascent. They have been so concerned about the gradual enlargement of their vocabularies, that they have paid slight attention to the ideas which the words were intended to convey. But just this gradation may be secured through the use of these stories, and it only needs that they should be written out in a form as simple, especially as regards the order of words, as that which obtains in the reading-books of equivalent grade." And this fine passage serves more purposes than one to show why American classics should be read in school: "The common-school system is the one vast organization of the country, elastic, adapted in minor details to local needs, but swayed by one general plan; feeling the force of educated public sentiment, and manipulated by the free, intelligent association of teachers and superintendents. This organization affords the most admirable means for the cultivation and strengthening of the sentiment of patriotism, and it avails itself of it in many ways." We are perfectly safe in taking Mr. Scudder for our guide in the matter of literature in the schools.

Children's Stories of the Great Scientists. By HENRIETTA CHRISTIAN WRIGHT. New York, Scribner. 8°. $1.25.

THE present volume, which is accompanied by eight good engravings, — portraits of some scientists, — describes the life and work of a number of the most energetic and successful workers in natural science, the author's object being evidently to bring out the lesson taught by their lives, more than to state the results of each one's labor; at least, such we should consider the prime object of biographies of scientists intended for children. In some instances the author has well succeeded in bringing out the instructive part of the lives of these men, and these we consider the best stories contained in the book; but in others a mere compilation of events and discoveries is given, while the character and importance of the man cannot be understood from the description. Among this latter class is, for instance, the chapter on Alexander von Humboldt. Many of the discoveries of physicists as described in the book will hardly be intelligible to children, as they deal with the most difficult problems of science. As an introduction into the history of natural science, the book has, however, a certain merit. The seventeen men whose lives and works are described are the most prominent of the last centuries; and whenever the author pays attention to their struggles and sufferings for the sake of their science, as is done in many cases, the descriptions are suggestive and instructive to the child.

Our Celestial Home. By J. G. PORTER. New York, A. D. F. Randolph & Co. 16°. $1.

THIS book is written by an astronomer, and is an attempt to prove that heaven is somewhere in the stellar universe, though the author is careful not to say where. He contends, that, according to the Bible, heaven is a material place, and not merely a happy state of existence, and must therefore be somewhere in the universe that we see around us. He gives a chapter to the subject of the immensity of the universe as made known by the telescope, and then considers the question of its stability. Science, he thinks, has shown the universe to be stable as to motion, but speaks with some hesitation with regard to the forces of heat and light. The earth, he intimates, may one day be destroyed by conflagration caused by collision with some swarm of meteors, thus fulfilling the prediction of scripture. Professor Porter is wholly uncritical in his religious views; for he believes not only in the future destruction of the earth, but also in the literal resurrection of the body, in the doctrine that death is the result of Adam's fall, and much else that liberal Christians of the present day have discarded. Indeed, his book is neither religious nor scientific in the higher sense of these terms, and is not likely to make any impression on intelligent minds.

Soaps and Candles. Ed. by J. CAMERON. Philadelphia, Blakiston. 12°. $2.25.

THIS little book is one of a series of technical handbooks, of which those already published are on 'Brewing, Distilling, and Wine-Manufacture;' 'Bleaching, Dyeing, and Calico Printing;' 'Acetic Acid and Vinegar, Ammonia and Alum;' and 'Oils and Varnishes.' As in the preceding numbers of the series, the articles in 'Cooley's Cyclopædia' have formed the nucleus to which material has been added from various scattered sources. It is assumed that the reader has some knowledge of chemistry.

Examples in Physics. By D. E. JONES. London and New York, Macmillan. 16°. 90 cents.

AS the author well remarks, "it is quite common to find students who have a correct knowledge of the general principles of physics, and can apply it intelligently in making a physical measurement, but who are yet unable to solve an easy problem or to calculate the results of their experimental work." Every one who has been brought face to face with some numerical example in the course of his study of physics has had cause to regret that he has not had more practice in such work, and it is just this opportunity for practice that 'Examples in Physics' is intended to supply in its more than one thousand problems.

NOTES AND NEWS.

THE National Geographic Society signalized the beginning of the second year of its successful work by publishing almost simultaneously with its first meeting of the season Vol. I., No. 1, of *The National Geographic Magazine.* In outward appearance it is as attractive as its contents are creditable to the society, by which it is not only edited, but written. Its outward covering is of the, at present, fashionable brick-color, upon which is printed in plain type the title of the magazine, the seal of the society, and the place of publication. The paper is of good quality, and the typography clean and sharp, so the page is easily read. But the contents are most deserving of praise. Besides the opening announcement, introductory address by the president, proceedings of the National Geographic Society, and facts relating to it, there are six carefully prepared articles. Their titles are, 'Geographic Methods in Geologic Investigation,' by William M. Davis; 'Classification of Geographic Forms by Genesis,' by W. J. McGee; 'The Great Storm of March 11 to 14, 1888,' — two articles, the first a brief one, by Gen. A. W. Greely, and the second a very elaborate study of its entire history, by Everett Hayden. The latter paper is illustrated by six carefully prepared colored charts, upon which is shown graphically almost every known fact relating to this great storm. This paper, with the charts, has also been reprinted in a pamphlet. The two remaining papers are, 'The Survey of the Coast,' by Herbert G. Ogden; and 'The Survey and Map of Massachusetts,' by Henry Gannett. In the introductory announcement the editors say: "The National Geographic Society has been organized 'to increase and diffuse geographic knowledge,' and the publication of a magazine has been determined upon as one means of accomplishing these purposes. It will contain memoirs, essays, notes, correspondence, reviews, etc., relating to geographic matters. As it is not intended to be simply the organ of the society, its pages will be open to all persons interested in geography, in the hope that it may become a channel of intercommunication, stimulate geographic investigation, and prove an acceptable medium for the publication of results. The magazine is to be edited by the society. At present it will be

issued at irregular intervals; but, as the sources of information are increased, the numbers will appear periodically. The national capital seems to be the natural and appropriate place for an association of this character, and the aim of the founders has been, therefore, to form a national rather than a local society. As it is hoped to diffuse as well as to increase knowledge, due prominence will be given to the educational aspect of geographic matters, and efforts will be made to stimulate an interest in original sources of information. In addition to organizing, holding regular fortnightly meetings for presenting scientific and popular communications, and entering upon the publication of a magazine, considerable progress has been made in the preparation of a physical atlas of the United States. The society was organized in January, 1888, under the laws of the District of Columbia, and has at present an active membership of about two hundred persons. But there is no limitation to the number of members, and it will welcome both leaders and followers in geographic science, in order to better accomplish the objects of its organization."

— Lieut. Robert Platt, U.S.N., has been ordered from the Washington Navy-Yard to command the United States Fish Commission steamer 'Fish Hawk.'

— As the stormy season on the North Atlantic approaches, the Hydrographic Office at Washington again reminds navigators, in a note on the November Pilot Chart, of the great advantage to be derived from the use of oil to prevent heavy seas from breaking on board. The forcing of the attention of mariners to this subject, so that now no careful master of a vessel goes to sea without providing for the use of oil in storms, has been one of the most important results of the work of the Hydrographic Office.

— Prof. Harry King of the Geological Survey has returned to Washington from Clark County, where he has been roughing it, much improved in health.

— In the summary of Mr. J. W. Osborne's paper on 'Substances Feebly Sensitive to Light,' which appeared in *Science* of Oct. 26, the fact that it was read before the Washington Philosophical Society was accidentally omitted. In the same issue, by some slip of the pen or types, Mr. J. B. Smith was represented as saying that he had captured and identified *four* distinct species of June-bugs in the District of Columbia. The number was really twenty.

— The titles of the papers read at the meeting of the Biological Society of Washington, Nov. 3, were, 'Fossil Wood and Lignites of the Potomac Formation,' by Mr. F. H. Knowlton; 'Observations on the Modifications of the Gill in Univalve Mollusks,' by W. H. Dall; 'Characteristics of the *Scatophagidæ*,' by Dr. Theo. Gill; 'Description of a New Species of *Arvicola* from the Black Hills of Dakota,' by Dr. C. Hart Merriam. Some notice of the first of these papers will be given in a future number of *Science*, if space permits.

— At the second meeting for the season of the National Geographic Society at Washington, Nov. 2, the paper of the evening was presented by Mr. Marcus Baker, on 'Classification of Surveys.' *Science* hopes to give an abstract of this paper in an early issue.

— The Australasian Association for the Advancement of Science held its first meeting in August of this year. The formation of the association was first suggested by Professor Liversidge of the Sydney University, during the exhibition in Sydney in 1879; but, matters at that time not being considered quite ripe for it, the formation of the association was again brought forward through the press in the year 1884. It was then suggested that the first general meeting should be held in Sydney on the one hundredth anniversary of the foundation of the colony, as it was at that time thought there would be an international exhibition in Sydney to celebrate that event. In furtherance of the project, a preliminary meeting of delegates from various scientific societies was held in Sydney in 1886 (November), the project having thus early met with the approbation and support of the majority of the learned and scientific societies of Australasia. At this meeting the formation of the Australasian Association for the Advancement of Science was agreed to unanimously, the rules of the British Association being adopted until the first general meeting. In accordance with a resolution passed at the meeting of delegates, the election of officers for the year 1888 took place in Sydney in March of the present year: Mr. H. C. Russell, B.A., F.R.S., government astronomer of New South Wales, being elected president; Sir Edward Strickland, K.C.B., F.R.G.S., honorary treasurer; and Professor Liversidge, M.A., F.R.S., and Dr. George Bennett, F.L.S., honorary secretaries. The formation of the general council was afterwards proceeded with, each society electing one representative for every hundred of its members. Practically every society coming within the scope of the association has one or more representatives on the general council. The association is thoroughly Australasian in its character and members, and the succeeding general meetings are to take place in turn in the capitals of the other colonies, the executive officers being elected year by year by the colony in which the meeting is held. It has been decided, however, that Sydney shall be the permanent headquarters of the association, and that Professor Liversidge shall be the permanent honorary secretary. The first general meeting was held at the Sydney University, the opening ceremony taking place on Tuesday evening, Aug. 28, when the presidential address was delivered. On the following day the sectional meetings commenced; and all the sections, with one exception, brought their proceedings to a close with the end of the week. About a hundred and ten papers were sent in by gentlemen of distinction in the various branches of science, literature, and art in the different colonies, and a considerable number of the papers are to be published in full in the first volume, soon to be issued by the association. It may therefore be anticipated that the work done by the association during the first year of its existence is of a highly important and useful character. The more solid work of the meeting was lightened by excursions to various places of interest to geologists, botanists, and others, and every effort was made to provide for the entertainment and comfort of visiting members, numerous entertainments being given by leading citizens. It has been decided that the next meeting shall be held in Melbourne, and Baron Sir Ferdinand von Mueller, the government botanist of Victoria, is the president-elect for the year. In 1890 the association is to meet in New Zealand. The rules are practically the same as those of the British Association, and, at the time of the meeting, the new association numbered about 850 members. It is confidently anticipated that this number will be considerably augmented, if not actually doubled, by the time the next general meeting is held.

— "The learning peculiar to the pedagogue ofttimes brings the pedagogue to contempt." In the 'Second Lessons in Arithmetic' (Houghton, Mifflin, & Co.) we are glad to note that the object of the editor, Mr. H. N. Wheeler, has been to prepare a text-book which, by its method of developing the mind of the learner, by the emphasis that it places on fundamental principles, and by the omission of useless subjects and arithmetical terms known only in the school-room, will meet the wants of those teachers and business-men throughout the United States who demand that the essentials of arithmetic shall be better taught than heretofore, and that the non-essentials shall be omitted. —— Mr. Walter Besant has written a biography of the author of the 'Gamekeeper at Home' and the 'Amateur Poacher;' and this 'Eulogy of Richard Jefferies' will be shortly published in New York by Longmans, Green, & Co. Mr. Besant has a sympathetic and tender touch, and his account of the struggles of unfortunate Jefferies is pathetic and affecting.

— The late Prof. Edward Tuckerman made a choice collection of books and papers relating to lichens, some four hundred numbers in all, which has been presented by Mrs. Tuckerman, in accordance with his own wish, to Amherst College Library. It is proposed to keep the collection by itself, under the name of the 'Tuckerman Memorial Library,' and to make it worthy of the name by making it as complete as possible in its own department. Supposing that some persons interested in this specialty might like to assist in maintaining and completing the collection (with the understanding that it is always available to public use), the librarian of Amherst College, William I. Fletcher, has issued a circular giving opportunity for any who care to do so to contribute, either in money or in material (especially rare monographs that may have escaped

Professor Tuckerman's notice), to this memorial to a model scholar and scientist. Whatever money may be contributed will be kept as a fund, of which only the income will be employed in making additions to the collection, or in repairs and rebinding. The sum of a thousand dollars would probably suffice as such a fund.

— An interesting incident of the statistics showing the social, sanitary, and economic condition of women employed in shops and factories of the United States, which are to be published in Col. Carroll D. Wright's annual report of the Bureau of Labor, is that they were collected by women who were employed as special agents of the bureau for that purpose. More than seventeen thousand women were interviewed.

— Prof. Aug. Kerckhoffs, of Dutch origin, but who has long been settled in Paris as a teacher of languages in a commercial school, will succeed the late Herr Johann Martin Schleyer as head of the Volapükists. Father Schleyer published his first book on Volapük in 1879, and nine years later, at the time of his death, a moderate estimate puts the number of his followers at not less than a quarter of a million persons. Professor Kerckhoffs is the most distinguished of his pupils.

— In *Science*, No. 300, p. 207, line 21, for '$\frac{1}{110}$' read '$\frac{1}{1100}$.'

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

On the Alleged Mongolian Affinities of the American Race: A Reply to Dr. Daniel G. Brinton.

A FEW days ago a paper of Dr. Daniel G. Brinton, entitled 'On the Alleged Affinities of the American Race' (*Science*, Sept. 14, 1888), came to my knowledge.

This paper, which purports to be a refutation of the asserted Mongolian affinities of the American natives, contains, in my estimation, such wrong interpretation of acknowledged facts, and such illogic argumentation, that, although I generally avoid discussions of this kind, I cannot help making an exception this time.

It would be worth while to examine and criticise thoroughly all the arguments brought forward in Dr. Brinton's paper, but a general review will sufficiently show the nature and value of Dr. Brinton's refutation.

Unfortunately, for the present I am compelled to discuss the matter in a rather incomplete way, as I am travelling, and do not have the necessary works at hand from which I should like to quote, in order to prove what I say. I have therefore to make all my statements and quotations from memory.

Let us examine now Dr. Brinton's arguments against the asserted Mongolian affinities of the native Americans, as existing in language, in culture, and in physical peculiarities.

First, as to language. In claiming that there is no linguistic connection between the American and Mongolian languages, which may be true, Dr. Brinton forgets that also in the (his) Mongolian race the various languages are far from showing any connection one with another, and yet he considers the peoples who speak these different languages as being of one race. Moreover, in the Caucasian and negro races of Blumenbach's classification, which Dr. Brinton seems to adopt, widely different languages, not showing the remotest linguistic connection, have been grouped together. For instance: the Basques, the Caucasians proper (of the Caucasus), the Semites, and numerous other groups of peoples, are considered to be of one race, the white or Caucasian. The African negroes, the Melanesians, the Negritos of the islands of south-eastern Asia, and the Australians, are equally regarded as forming another, the black or negro race. Although there is no linguistic affinity between the different groups just mentioned, they are affiliated by physical characteristics, and each forms respectively one great race. As long as we accept this, we have a perfect right to group the Ural-Altaic, and other Mongolian languages, with the native languages of America.

Second, as to culture. Although I am far from professing that ancient American culture has borrowed any thing from Europe, Asia, or Africa, neither do I positively deny the contrary until further evidence.

The science of archæology, as Dr. Brinton himself admits, only came into being at a comparatively recent date. If this be true of archæological science in general, it is more so of American archæology in particular, and we are consequently very far from having exhausted it. The different branches of ancient American culture, from the arid regions of the South-west to Peru, have not yet been studied systematically enough, and in connection with ethnology (as they should be), to permit us at present to draw any certain conclusions as to whether they contain any foreign elements, Mongolian or otherwise.

There is no need whatever as yet of hurrying Americanists, as Dr. Brinton wishes, to recognize the absolute autochthony of native American culture. The coming-forth of truth from studying a branch of science cannot, and never will, be forced: it *grows*, gradually and slowly, in the same proportion as our knowledge increases.

Third, as to physical peculiarities. Putting aside for the present linguistic and cultural affinities between Mongolians and native Americans, to deny that the American aboriginal belongs by his physical characteristics to the Mongoloids is equal to denying that the Basques and the Fins belong somatologically to the white race, or to claiming that the Hottentots and the Negritos do not form branches of the black race.

The comparative study of physical characteristics is perhaps the only satisfactory way of classifying the human races; and, although I cannot deny that any other classification, linguistic or sociologic, has its value and right of existence, we never ought to try to harmonize and to unite them, as is often done. As the different classifications have as many absolutely different points of view, their union can only lead to erroneous estimations. This illustrates, that, even admitting that the languages and cultures of the native American are not Mongoloid or Mongolian, nevertheless the physical peculiarities of these races may be the same.

Before I continue, let me state what I call, on purely somatological grounds, the Mongoloid race. Mongoloids, or Mongolians, in the widest sense, are, to me, a number of zoölogical varieties (*variété héréditaire*, in the sense of A. de Jussien) of the same subspecies or race, distributed promiscuously, and in different proportions (in the sense of Kollman's *penetratio*: see Kollman's studies on European and American anthropology, in *Archiv für Anthropologie* and *Zeitschrift für Ethnologie*), over parts of northern and eastern Europe, the greater portion of Asia, the Indian Archipelago, Polynesia, a part of Madagascar, and originally over the whole American continent with its numerous islands. The term 'Mongoloid,' as I understand it, is in the main synonymous with Oscar Peschel's '*Mongolenähnliche Völker*,' and with the '*races jaunes*' of French anthropologists.

The varieties of this great race differ somatologically much less among themselves than the varieties of the white and black races.

I will now consider, one by one, the arguments of Dr. Brinton against the racial relationship between Mongoloids and American natives.

First, as to color. Dr. Brinton forgets, that, in condemning Cuvier for the confusion of the American with the Mongolian race, because he based his racial scheme principally on the color of the skin, he equally condemns Blumenbach, whose division Dr. Brinton first calls 'eminently scientific.' We know that Blumenbach divided mankind into a white, yellow, brown, red, and black race, — a division at least just as much an '*a priori* hypothesis,' as it pleases Dr. Brinton to call Cuvier's divisions. Blumenbach had probably seen just as few pure Mongolians and American natives as Cuvier; otherwise he would not have called the Americans red. True 'redskins' do not exist. The American aboriginal is assuredly more yellow than red.

As far as my own observations among Indians go, in North and South America and in Mexico, and among Chinese, Japanese, and Malays, I have come to the conclusion that they all have the same color of skin, which we might best call yellowish brown, but in a great variety of shades, which often occur among the same people

or tribe, and depend upon age, sex, and general health. Exposure, mode of living, climate, and altitude are, furthermore, the main factors which determine the many different shades of the color of the skin, not only among the Mongoloids, but also among the white and black races.

Let us suppose for a moment that the color of a Mongolian were yellow, and that of an American red: would it ever occur to a modern anthropologist to classify them for this reason in a separate and distinct race?

There is no race in which both the color of the skin and the color of the hair vary more than in the white. Think of a blond, florid complexioned Teuton, and an Italian with raven-black hair and dark skin. And yet, on account of the rest of their physical characteristics, they belong to the same race.

After this, what Dr. Brinton said about the difference between the character and color of the hair of Mongolians and Americans needs no further refutation.

Although I have probably studied somatologically more American Indians, and have examined more of their skulls, than any other anthropologist living, as yet I hesitate to name "a positive cranial characteristic of the red race." At any rate, Dr. Brinton is mistaken in thinking that the *os Incæ* is found in its extreme development in the "American race," and in its greatest rarity among the Mongolians. What in the days of Von Tschudi seemed true, has been refuted since. As I write this without any books at my disposal, and simply quote from memory, I cannot now give any statistics of the relative frequency of this anomaly in different races, but would refer to Virchow's and my own investigations on this subject (VIRCHOW, *Ueber Merkmale niederer Menschenrassen am Schädel;* TEN KATE, *Craniologie der Mongoloiden*).

Although it is true that the glabella is more prominent in American skulls than in Altaic or northern Mongoloid crania, this is no argument to separate them racially from each other. The African negroes, for instance, seldom have a prominent glabella; the Australians, on the contrary, have, as a rule, an exceedingly strongly developed glabella; but nevertheless both African negroes and Australians are considered as belonging to the same race.

As far as the "Aymarian depression" is concerned, one might as well call all different artificial deformities of the skull, those in Europe included, racial characteristics. They are merely incidental, and belong as much to the domain of ethnology as to that of physical anthropology.[1]

It is not quite correct to assert, that, "of all the peoples of the world, the Mongols, especially the Turanian branch, are the most brachycephalic."

Many years ago, in the days when our craniologic knowledge was very limited, we had reason to believe this to be a fact; but since one armchair anthropologist copied this statement from the other, and since Aitken Meigs studied craniology after very imperfect methods, facts have accumulated to show that in America also we find extreme brachycephaly, as well among the prehistoric as among the historic peoples, from British America to Patagonia. At the same time extreme dolichocephaly is found, besides among the Eskimo, throughout the American Indian tribes, from north to south; but it cannot be considered an American craniologic characteristic, for among the Asiatic tribes dwelling nearest to the Eskimo (the Aleuts, for example), dolichocephaly in a marked degree is found, which fact is in absolute contradiction to Dr. Brinton's assertion (see, among other works, DE QUATREFAGES and HAMY, *Crania ethnica;* KOLLMAN, 'Die Autochthonen Amerika's,' in *Zeitschrift für Ethnologie*, 1883; TOPINARD, *Eléments d'Anthropologie générale;* and my own publications in American and Asiatic anthropology).

The value of the so-called 'Mongolian eye' (*l'oeil bridé*) may have been exaggerated as a racial characteristic: it is nevertheless very frequent among children, both of Mongolians and native Americans, as also among women, more than in any other race I know of. As it is admitted that in all races women and children show certain racial characteristics, especially those belonging to physiognomy, better than men, we may safely call the Mongolian eye a racial characteristic, though perhaps of less importance.

As regards the nasal index, before we can draw any conclusions from it, we have to make a distinction between the nasal index of the living (*sur le vivant*) and the nasal index of the bony skull, which often are in no correlation at all. Such is the case among the Eskimo, who are leptorrhinic, and belong at the same time to the same group as the American and northern Asiatic tribes.

To come to Dr. Brinton's last argument against the asserted Chinese traits of certain American tribes, I must say, that, although I never have seen any living Botocudo, I have examined their crania, and find that there is a certain resemblance between them and those of the Eskimo. If I am not wholly mistaken, Dr. Ph. Rey, who has also lived among the Botocudo, has pointed out this similarity in his anthropological study on this tribe (Paris, 1880).

I cannot say whether the tribes of the North-west Pacific coast have any Chinese traits, as I have not seen them myself; but this I can state, that among several tribes in North and South America (for example, Iroquois, Apaches, Hualapais, Maricopa, Pima, Carib, Arowak) I have seen persons who strongly resembled not only Chinese, but also Japanese and other Mongolians, and even Malays.

In some of them this similarity was so marked, that once on the Demerara River, in British Guiana, I questioned some Indians of the Ackawoio tribe, to convince myself that they were not Chinamen.

Dr. Brinton admits that the Eskimo "possess in some instances a general physiognomical similarity," concluding that "this is all," and "not worth much as against the dissimilarities mentioned." Does not Dr. Brinton know that physiognomy is really a very important consideration in racial distinctions? Every anthropologist knows that physiognomy is a complex of different traits, several of which are first-class racial characteristics. I will only mention the general shape of the forehead, the implantation and form of the nose, and the breadth and length of the face. If physiognomical characteristics had as little value as Dr. Brinton seems to think, then we might as well give up the study of physical anthropology altogether.

To recapitulate my criticism, I wish to say that Dr. Brinton's argumentation against the affinity between Americans and Mongolians is based upon entirely wrong reasoning. If the reasons he gives were correct, then the classification of the other races of the human species would be equally wrong; for in each of them peoples are grouped together, which, although related by physical characteristics, are linguistically and ethnologically entirely different from each other, not to speak of the difference in their psychological and social evolution.

When I admit that the native Americans are Mongoloids, I do not necessarily imply that America has been populated from Asia or elsewhere. However, if we accept the theory of evolution, this is the most probable explanation of the observed facts. But, leaving the doubtful origin of the Americans, and of their languages and arts, out of the question, I maintain that there is a physical similarity, racial affinity, and relationship between the indigenous Americans and the Mongolians in the widest sense.

This is, in the present state of anthropological knowledge, an undeniable fact. He who denies it does not believe in physical anthropology; and not to recognize this branch of science is equal to denying natural history in general. DR. H. TEN KATE.

Mexico, Oct. 8.

[1] Although Dr. Brinton does not mention any ethnologic peculiarities as having been asserted in favor of the affinity between Mongolians and Americans (for they have been asserted), I think it would have been worth while to discuss them. What I said above about the study of archæology is equally true in regard to ethnology. Systematic and comparative, and, above all, empiric ethnological researches, both among the native Americans, especially the northern, and among different Mongolians, particularly the Siberian tribes, would throw much light upon their relationship. I think, for example, that we will never be able to understand thoroughly the ethnology of the Tinné tribes, as long as the Mongolians proper, and certain erratic tribes in the Gobi, have not been studied.

Queries.

38. WHEN WAS THE BILLION CHANGED?—Can any of the readers of *Science* state at what time, and from what incentive (by what fatuity), the people that has proposed a system of metrology for universal adoption depreciated the arithmetical *billion* (the second power of the million) to a nominal 'trillion,' making the anomalous 'billion' one-thousandth of its explicit value?

W. B. T.

Washington, D.C., Oct. 31.

Publications received at Editor's Office, Oct. 29–Nov. 3.

BRAY, H. T. Essays on God and Man, or a Philosophical Inquiry into the Principles of Religion. St. Louis, Mo., Nixon-Jones Printing Co., Pr. 270 p. 12°. $2.

COLSON, F. H. Stories and Legends. A First Greek Reader. London and New York, Macmillan. 219 p. 16°. 75 cents.

FISHER, W. W. A Class Book of Elementary Chemistry. Oxford, Clarendon Pr. 272 p. 12°. (New York, Macmillan, $1.10.)

GIBSON, W. S. An Introduction to Latin Syntax Oxford, Clarendon Pr. 144 p. 16°. (New York, Macmillan, 50 cents.)

HALL, H. S., and STEVENS, F. H. A Text-Book of Euclid's Elements. Parts I. and II. London and New York, Macmillan, $1.10.

HARDY, H. J. A Latin Reader for the Lower Forms in Schools. London and New York, Macmillan. 187 p. 16°. 60 cents.

KANE, J. J. Ilian; or, The Curse of the Old South Church of Boston. Philadelphia, Lippincott. 368 p. 16°. $1.25.

PORTER, J. G. Our Celestial Home: An Astronomer's View of Heaven. New York, A. D. F. Randolph & Co. 116 p. 16°. $1.

ROSENBUSCH, H. Microscopical Physiography of the Rock-Making Minerals. Tr. by J. P. Iddings. New York, Wiley. 333 p. 8°. $5.

SARGENT, J. Y. A Latin Prose Primer. Oxford, Clarendon Pr. 160 p. 16°. (New York, Macmillan, 60 cents.)

STARR, L. Hygiene of the Nursery. Philadelphia, Blakiston. 212 p 8°. $1.50.

STEPHENSON, H. M. P. Vergili Maronis Æneidos, Lib. IV. London and New York, Macmillan. 84 p. 24°. 40 cents.

STODDARD, C. W. The Lepers of Molokai. Notre Dame, Ind., Ave Maria Pr. 80 p. 16°. 10 cents.

STONE, E. D., *ed.* Selections from Xenophon's Anabasis, Book IV. London and New York, Macmillan. 98 p. 24°. 40 cents.

STRACHEY, R. Lectures on Geography delivered before the University of Cambridge during the Lent Term, 1888. London and New York, Macmillan. 211 p. 12°. $1.25.

SYDNEY, Handbook of. For the Use of the Members of the Australasian Association for the Advancement of Science. Ed. by W. M. Hamlet. Sydney, Turner & Henderson. 116 p. 16°.

SYMONS, G. J., *ed.* The Eruption of Krakatoa, and Subsequent Phenomena. London, Trübner. 494 p. 4°. 30 shillings.

TATHAM, M. T., *ed.* Livy, Book XXII. Oxford, Clarendon Pr. 148 p. 16°. (New York, Macmillan, 60 cents.)

TAYLOR, E. Is Protection a Benefit? A Plea for the Negative. Chicago, A. C. McClurg & Co. 274 p. 16°. $1.

TRENCH, R. C. On the Study of Words. 20th ed., revised by Rev. A. L. Mayhew. New York, Macmillan. 348 p. 16°. $1.

TRUMBULL, G. Names and Portraits of Birds which interest Gunners. New York, Harper. 221 p. 12°.

TYNDALL, J. Researches on Diamagnetism and Magne-crystallic Action, including the Question of Diamagnetic Polarity. New York, Appleton. 288 p. 12°. $1.50.

UNDERHILL, H. G. Easy Exercises in Greek Accidence. London and New York, Macmillan. 126 p. 16°. 50 cents.

U. S. DEPARTMENT OF AGRICULTURE, Report of the Commissioner of, 1887. Washington, Government. 724 p. 8°.

U. S. GEOLOGICAL SURVEY. Topographical Maps of Portions of Massachusetts, Connecticut, New York, Rhode Island, New Hampshire, and Texas. Washington, Government, 1888. 20 maps, 42 by 50.5 cm. $1.50.

UNITED STATES, Tenth Census of the, 1880. Vol. XVII. Part II. Water-Power of the United States. Washington, Government. 788 p. 4°.

—— Same. Vol. XIX. Part II. Social Statistics of Cities. Washington, Government. 843 p. 4°.

VERNEY, Lady. How the Peasant Owner Lives in Parts of France, Germany, Italy, Russia. London and New York, Macmillan. 234 p. 12°. $1.

WARNER, C. D. A-hunting of the Deer and Other Essays. (Riverside Literature Series, No. 37.) Boston and New York, Houghton, Mifflin, & Co. 85 p. 16°. 15 cents.

WELCH, A. S. Talks on Psychology applied to Teaching. (The Reading Circle Library, No. 6.) New York and Chicago, E. L. Kellogg & Co. 136 p. 16°.

WHEELER, H. N. Second Lessons in Arithmetic. Boston and New York, Houghton, Mifflin, & Co. 282 p. 16°. 60 cents.

WINLOCK, W. C. Bibliography of Astronomy: for the Year 1887. Washington, Smithson. Inst. 63 p. 8°.

WISCONSIN, Fifth Annual Report of the Agricultural Experiment Station of the University of, for the Year ending June 30, 1888. Madison, State. 184 p. 8°.

WITHERSPOON, O. Doctor Ben: an Episode in the Life of a Fortunate Unfortunate. Boston, Ticknor. 382 p. 16°. 50 cents.

WORCESTER, J. E. Worcester's Academic Dictionary. Philadelphia, Lippincott. 688 p. 12°. $1.50.

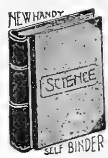
WRIGHT, Henrietta Christian. Children's Stories of the Great Scientists. New York, Scribner. 350 p. 12°. $1.25.

PUBLISHER'S NOTES.

The Alfred Dolge Felt Shoes and Slippers.

To keep the head cool and the feet warm is one of the first laws of hygiene; yet no part of the body has been more habitually abused and neglected than the foot, without a healthy condition of which, general good health is impossible. There are comparatively few in this climate who do not suffer in some manner from tenderness of the feet, caused by wearing rubber or fine-grained leather shoes, which permit of little or no ventilation, and which prevent the evaporation of the perspiration, thus keeping the feet constantly wet or damp. The ALFRED DOLGE, ALL-WOOL FELT SHOES, to be had in New York of Daniel Green & Co., 122 East 13th Street, are provided to meet this special need. It is guaranteed that the felt in these shoes is made of *pure live wool*, which absorbs and disperses the perspiration with its impurities, and keeps the feet dry and in a healthy condition. The process of making the Alfred Dolge felts is protected by patents, and his felts are not sold to other shoe-manufacturers.

Schools.



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SCIENCE

FRIDAY, NOVEMBER 16, 1888.

THE DRIFT OF PUBLIC discussion in England, not only among scientists, but also among athletes and others interested in physical training, seems to be against the acceptance of Professor Roy's defence of stays and corsets, at the recent meeting of the British Association. Some of the leading journals of London were instant in their approval of Professor Roy's theories; but where they have done so, immediate protests have come from their readers. *The Spectator*, for instance, in a recent number, after quoting Professor Roy's assertion that the desire for waist-belts is instructive, and has been displayed by all athletes, and persons of whom exertion is required, since the beginning of history, adds, "It will be observed that this argument, which is certainly true of all runners, Asiatic or European, applies to men equally with women, though men gird themselves only to meet special calls upon their strength." To this a recent graduate from Cambridge, where he was distinguished as a runner and long-distance bicycle-rider, protests that neither runners nor experts upon the wheel, at that university, ever used, or showed a desire to use, tight waist-belts. On the contrary, it was their custom to gird themselves as loosely as possible in order to allow free movement of the diaphragm. If rowers even wear waist-belts, they are so loose as to cause no interference with the freest movements of all the muscles of the body. It is probable that the habit of "girding up the loins" preparatory to physical exertion originated in Oriental countries, where in ancient times, and now as well, the peculiar form of the prevailing costume made it necessary in order to secure free movement of the limbs. A custom once established, needs no further explanation. It may survive long after there is any reason for it. The Hittites wore peaked-toed, turned-up shoes thousands of years after their ancestors had come from the mountains of the north, where the form of their snow-shoes suggested the peculiar fashion; and the daily life of every people is full of instances that might be cited. Nobody to day places restraint upon any of his organs if he desires to excel in feats of strength or speed. He may wear a waist-belt, but it is never so tight, as has already been remarked as to rowers, as to interfere with the free play of the muscles.

THE VERY ABLE PAPER on hydraulic degradation, by Director J. W. Powell, published elsewhere in this issue of *Science*, is the result — it would not be safe to say 'the final result' — of more than a dozen years of study and observation upon the subject. Former publications have simply indicated the direction in which this investigation was proceeding, and announced some of the conclusions reached. This is a comprehensive, brief, pointed, and easily understood exposition of the whole subject. *Science* congratulates itself upon being the first journal of its class, or of any class, to present this admirable paper to its readers. Major Powell is understood to invite comment, criticism, and discussion of the paper, and *Science* will gladly open its columns to communications on the subject.

THE APPROACHING RESIGNATION of Dr. John B. Hamilton, Surgeon-General of the Marine Hospital Service, to accept the editorship of the *Journal of the American Medical Association*, adds another to the frequent examples of the difficulty of retaining the bright men of science in the public service. During the last ten years Dr. Hamilton, by his energy and intimate knowledge of the service, has been able to carry out many reforms that could not otherwise have been effected. One very important one is the examination of pilots for color blindness, the establishment of new hospitals, the perfecting of the hospital regulations, which amounted to a thorough reorganization of the service and its general advancement, until, as *Colburn's United Service* (London) has declared, it is "the gem of the mercantile marine of the world." The means of preventing the spread of epidemics have been so simplified by Dr. Hamilton that most places subject to epidemic visitations have practically adopted the methods brought into use in this country by him. Dr. Hamilton's remarkable energy will soon make its effect felt in the pages of the *Journal*. Nothing is slow or dull that he has to do with, not even a medical journal. He will force others to quote from him, instead of making the *Journal*, as too many similar publications now are, a judicious selection of extracts from the exchanges. His Washington friends, of whom there are many, for he is personally very popular, will regret the loss of his society, but rejoice at his promotion.

THE LAWS OF HYDRAULIC DEGRADATION.[1]

THE lands of the earth are degraded by water, by ice, and by winds; hence in discussing geological degradation it becomes necessary to recognize hydraulic degradation, glacial degradation, and æolian degradation.

In hydraulic degradation three methods may be distinguished. 1. The surface of the land is disintegrated by various methods and washed away by rains and melted snows. The rains gather into streams, as brooks, creeks, and rivers, and transport the disintegrated rock from one region to another. This general surface degradation may be called 'erosion.' 2. During the process of this transportation the streams carve channels for themselves, and this channel-cutting may be called 'corrasion.' 3. By erosion, and also by corrasion, cliffs are produced, and these cliffs are broken down by gravity. This method of degradation may be called 'sapping.'

Thus there are three methods of hydraulic degradation, — erosion, corrasion, and sapping.

There are three processes involved in erosion: (*a*) the rocks are disintegrated; (*b*) the disintegrated material is transported in water; (*c*) in order to be transported in water the material must be loaded. In like manner, there are three processes in corrasion, — disintegration, loading, and transportation. In sapping there are but two processes, disintegration and falling.

In erosion and corrasion the material which is transported may be called the 'load.' The load is transported by two methods, a portion floats with the water, and another portion is driven along the bottom. The water in which the load floats is the 'vehicle' of transportation. Gravity is the force of transportation, and acts alike on the water and on the load. In the same sense that the water furnishes its own moving force, through its inherent gravity, so the floating load furnishes its own moving or transporting force through its inherent gravity. Vehicle and floating load alike are moved by gravity. The vehicle can move without the floating load, but the floating load cannot move without the vehicle; that is, the water is the agency of flotation for the load.

The floating load is in general of greater specific gravity than the water, and while floating, it falls to the bottom and comes to rest, and the progress down-stream of the floating load ends. The excursion which each particle will make from the time it is loaded to the time it is deposited depends upon four conditions: First, specific gravity. If the specific gravity is greater, the particle is deposited sooner; if the specific gravity is less, the particle is carried

[1] A paper read before the National Academy of Sciences at its meeting in New Haven, November, 1888.

farther. Second, degree of comminution. If the particle is larger, it will fall sooner; if the particle is smaller, it will be carried farther, for the smaller the particle the greater the supporting surface in proportion to its volume. Third, the velocity of the water. If the velocity is decreased, the excursion of the particle will be shortened; if the velocity is increased, the excursion of the particle will be lengthened. Fourth, the depth of the water. If the water is shallow, the floating particle will sooner reach the bottom; if the water is deeper, the particle will be carried farther before it strikes the bottom. In this subject, therefore, we have to consider the specific gravity of the load, the comminution of the load, the velocity of the water, and the depth of the water.

As the water runs down the channel, it may roll sediment along the bottom. This is the driven load. Such sediment is moved by the impact of the water from above. But in order to do this the materials on the bottom of the water must present up-stream surfaces on which impact may act; that is, the bottom of the channel must present heterogeneity of surface. This heterogeneity may be of such a nature that the passing water may by impact lift the particles from the bottom so that they will be transported in the vehicle by their own gravity. To the extent that materials are rolled along the bottom by impact, the energy of the water is utilized in transportation; but to the extent that transportation is accomplished by flotation, the gravity of the particles themselves is the entire force of transportation. Whatever is driven is transported by the energy of the water; whatever floats is transported by its own inherent gravity. This statement is made fully, because it is fundamental, and because the principles involved have been neglected and serious error has arisen therefrom.

The particles floating in a stream collide, and there arises therefrom inter-particle friction, but if in the collision between two particles one is retarded, the other must be accelerated. If the particles are broken or ground by the process, work is done, and the energy involved must be derived from the total energy of the moving water and load. Some energy, therefore, must be lost by it, but the disintegration arising therefrom promotes transportation, as the smaller particles make longer excursions. Heat is also developed and dissipated, but perhaps the quantities involved are unworthy of consideration.

There is a degree of comminution that so approximates molecular disintegration that some geologists and chemists believe that a *quasi* or *pseudo* combination between the water and the load results therefrom: if this be the case the character of the fluid is changed and the degree of fluidity is diminished. Here, again, it may be possible that the quantities involved are so small that they may be neglected.

The volume of water remaining the same, if the velocity of the water is increased, the depth of the water is diminished. Therefore the excursion of the particle will be lengthened by the increase of velocity, but shortened by the decrease of depth, and the one compensates the other. On the other hand, to increase the velocity of a stream enables it to drive larger particles; and this ability increases with the sixth power of the velocity.

The load increases the volume of the stream to the amount measured by its own volume, and the load increases the mass of the stream to the amount of its own mass; and as the load is of higher specific gravity than the water, the mass is increased at a higher rate than the volume. As load increases volume, it thereby increases velocity; and as load still further increases mass, it still further increases the effective energy of gravity.

In order that transportation by flotation may begin, the detritus must be loaded in the water, and when it sinks to the bottom it must be reloaded that flotation may be continued. In erosion, loading is primarily effected by the impact of raindrops. This loading is continued, and reloading is accomplished by the flow of the water over the surface through its impact against obstructions, and thus the wash of the surface is carried into the stream. But the load in the water sinks when, if the declivity is sufficient, it will be driven, but if the declivity is insufficient, conditions for its reloading must be produced. The driven load often becomes floating load when the water plunges over great declivities, but the chief method of reloading is by lateral corrasion: this arises in the case of deposits which are built up until they become portions of the banks of a stream and are subsequently attacked by the stream and carried away. Reloading is therefore chiefly accomplished by the process of lateral corrasion.

As the load is of greater specific gravity than the water, all load is over-load in the sense that the load must be deposited because the water is unable to permanently hold it in suspension. An extreme condition of load may be reached, which is sometimes exhibited in nature, in which the particles are so crowded that they cannot move freely in suspension; that is, they are in part held in suspension by the water and in part supported in position by one another, and still the particles may be so fine that they will slowly move down stream: in this case the water moves faster than the particles, and is strained through them at varying degrees. Thus partial hydraulic suspension may exist. At the one extremity the suspension may be so nearly perfect that the load is scarcely retarded thereby. At the other extremity the movement of the load may be wholly stopped and the water will be strained through it. Under such conditions streams may disappear from the surface and run wholly underground, and may re-appear when the accumulated sands have been passed. The accumulated sands may be of such an extent as to absorb all the water and hold it until it evaporates. Streams that thus empty into dry valleys and sand plains are abundant in arid regions.

The friction of pure water is so slight that where the formations are hard, corrasion cannot be accomplished thereby (all processes of solution are here neglected); but where the formation is incoherent, corrasion may progress through the impact of the water against the more or less disintegrated particles lying at the surface of the bottom and banks or on the 'wetted perimeter.' In this case the particles must present surfaces up stream, against which the flowing waters may act. The surface of the bottom and banks must be heterogeneous. Such disintegration must be accomplished by some instrument, and this is the load which passes along the channel in course of transportation; and it may be affirmed, that, other things being equal, the greater the load the greater the corrasion, and the less the load the less the corrasion. Again, the banks of the stream may be disintegrated by sapping, and loaded on the water by gravity, and the rate of lateral corrasion will be greatly increased thereby. But corrasion furnishes additional load, and it may be further affirmed that the greater the corrasion the greater the load, and the less the corrasion the less the load.

Rain is discharged from the surface of the land by flowing in the direction of greatest declivity, and as multiform heterogeneous and opposing declivities meet, the line of junction becomes the channel. A stream may thus have a line of maximum depth. If the channel is straight and homogeneous the line of maximum depth is the central line of the stream, which in many cases may be a broad zone; but it is deflected, now to one side and now to the other, by curvature and by a multiplicity of other conditions. The instrument of corrasion is the load, and chiefly the driven load which is drawn toward the line of maximum depth down the opposite declivities of the wetted perimeter by gravity, and thus corrasion is more or less concentrated along the line of maximum depth. Finally, the line of maximum depth is the line of greatest velocity, where impact is at a maximum. Hence it may be affirmed that in vertical corrasion the line of maximum depth is the line of maximum corrasion.

The geological formations into which channels are cut are greatly varied in constitution: they may be granite, basalt, limestone, sandstone, clay, alluvium, etc. Many degrees of hardness and coherence are presented in these varying materials. The beds themselves are not co-extensive with the land, but are always limited by the conditions of their production. Every such formation is a comparatively small bed of sand, gravel, clay, limestone, granite, etc., as the case may be, and the bed itself is variable in structure, as in thickness, hardness, and general constitution, through many degrees.

Geological formations are primarily horizontal, but subsequently they may be tilted by diastrophic agencies, so that some beds are horizontal, some are inclined at varying degrees, and others are vertical. Where in its course a stream passes from bed to bed, the conditions of corrasion are changed; the harder bed corrades with more difficulty, the softer bed with less. Where the beds are vertical, this change along the course is at a maximum; where the

beds are horizontal the stream slowly passes from one bed to another by reason of its declivity, and when the dip of a formation coincides with the declivity of a stream, the change which arises in passing from one formation to another is reduced to a minimum.

Heterogeneity of terrain has an important effect upon corrasion. Hard beds are corraded with difficulty, soft beds with ease. By this means the channel is broken into sections or reaches, now shorter, now longer, with the varying heterogeneity of the terrain, so that soft beds present reaches of lower declivity and hard beds reaches of higher declivity. The low-declivity reaches are expanded and the high-declivity reaches are contracted. Where the changes are more abrupt the declivity becomes more abrupt, so that the stream may be made to plunge in a part of its course and to flow gently in another part. The efficiency of corrasion is greater in the softer reaches, but the corrading power of the stream is increased with declivity, and thus the corrading power is concentrated on the harder reaches.

Under the conditions so briefly set forth, the smallest stream has a more or less heterogeneous terrain, and a great river like the Mississippi possesses a terrain of indescribable heterogeneity.

As maximum corrasion is along the line of maximum flow, progressive deepening of channel produces progressive narrowing of the channel; but this tendency is counteracted in various ways. The narrowing of the channel is checked by the instability of the banks. If the banks are greatly coherent, long-continued corrasion may result in the formation of deep cañons. As cohesion becomes less, the banks fall into the stream and the channel is widened; and when the terrain is composed of disintegrated materials the channel is widened until the banks have the normal slope. If the terrain is permeable to water, the material creeps into the channel and the slope is still further reduced. Quicksands that become saturated to the level of the stream, flow out, and excessive widening results therefrom. In the progressive lateral corrasion of an alluvial bank by the impact of the stream which is turned against it, wetting secures disintegration, and the banks progressively fall into the water. When the wetted perimeter — which is that portion of the channel surface covered by water — is below the channel perimeter, sapping results, and the load is still further increased. Given sufficient time, indurated banks assume the normal slope. Alluvial banks speedily assume this condition through the agencies which, considered together, may be called 'weathering;' and through the ever-recurring wash of rains the slope is ever diminished. In like manner, the most indurated banks — as of basalt, granite, or limestone — are reduced to low slopes. The stream corrading vertically through indurated rocks steadily increases its vertical banks below, while the weathering steadily decreases them above; so that the height of the precipitous portion of the banks is the residual of opposing agencies.

Corrasion is greatly modified by the declivity of the stream. This declivity may be so great that no portion of the load is deposited along its course. All the load is transported by flotation or driving. Under these circumstances, if the terrain of the channel is sufficiently coherent, the corrasion will be wholly vertical, and its rate will increase with the declivity, as the impact of the corrading particles will be increased thereby. This vertical corrasion will produce cañons with precipitous walls until at last cliffs thus formed will be broken down by sapping. But when along the course of a stream the declivity is diminished so that any portion of the load is deposited, such deposit serves to protect the bottom of the channel and to check vertical corrasion, but at the same time the channel is choked by the material thrown down, and the waters passing down the channel are turned to one side, and lateral corrasion is inaugurated thereby. In the same manner lateral corrasion is produced by the sapping of the cliffs, as the fallen cliffs choke the channel of corrasion, and the river is thus turned against its banks, which are high walls. Lateral corrasion therefore arises from local deposition and from no other cause.

If the declivity of the stream is diminished to such an extent as to prevent vertical corrasion, whatever corrasion exists must be lateral corrasion; and here again, the greater the load the greater the deposition, and the greater the resulting corrasion.

When a river flows over a plain with declivity so low that vertical corrasion is wholly checked, it is in a condition where lateral corrasion is at a maximum under the existing circumstances. This lateral corrasion is greater as the load is greater. Other things being equal, declivity determines whether corrasion shall be vertical or lateral, through the intervention of deposition.

In vertical corrasion the load is the instrument by which the channel is abraded, and in lateral corrasion the load is still the instrument with which the work is performed, but it is used in a twofold manner: (1) it is the agency by which the stream is turned against its banks, and (2) it is still an instrument of abrasion.

The volume of water is increased by every affluent: it is therefore progressively enlarged from source to mouth, and the conditions of corrasion and transportation are greatly modified thereby. At the junction of an affluent the volume of the stream is enlarged, and the rate of corrasion is increased, vertical or lateral, or both. If the declivity of the affluent is much greater than that of the principal stream, the affluent brings with it load too coarse to be further transported. In this manner the main river is choked, and is interrupted by a series of dams constructed by the affluents. This is especially remarkable in streams running in cañons. Where these conditions prevail, that form of the channel which is usually produced by heterogeneity of terrain — that is, by harder or softer formations — is sometimes obscured, or even obliterated, by affluent dams. The corrasion which results from increase of volume of water and sediment causes the channel below the affluent to be cut faster than the channel above. In this manner, *ceteris paribus*, a stream decreases in declivity from source to mouth, and a 'normal curvature of stream declivity' is produced thereby.

The volume of the stream is variable from time to time, as it depends upon the fall of rain and the melting of snow. This variable is great, as the flood-water volume may be many times that of the low-water volume. Increase of volume which arises in this manner manifests itself in part as an increase in cross-section and in part as an increase in velocity, and the rate both of transportation and corrasion is increased thereby. Corrasion and transportation are increased by another condition that arises simultaneously with the increase of volume. The rainfall which produces this increase also produces surface erosion. Surface erosion is intermittent, as it is caused only by the wash of rain and snow. When the storms come, the load is increased at a much higher rate than the volume of water in the stream. At low-water time the load is precipitated, and clear water flows in the stream, so that corrasion, transportation, and deposition are reduced, or even suspended. At flood time corrasion, transportation, and deposition are at a maximum. Whenever an affluent receives a local rain the volume of water is increased and the volume of load augmented at a still greater rate. When such an affluent discharges into a main stream which is slightly or not at all affected by the rainfall, the new load is at once thrown down, and the affluent dam is increased. Affluent dams are primarily formed by sudden decrease of declivity, and are greatly enlarged by local increase of volume. The effect of affluent dams is to stimulate lateral corrasion below. In a region of great declivity this is expressed in the widening of the channel; in a region of somewhat less declivity it is expressed in the enlargement of the flood-plain; and in a region of minimum declivity it is expressed in changing the position of the channel.

It has been shown that the channel of a stream is widened and narrowed by varied conditions of terrain. In soft formations it is expanded, in harder formations it is constricted. Another variable arises through the agency of affluent dams, as already explained. There is still another agency by which this heterogeneity is increased. The grand terrain of a river is subject to deformations, in such a manner that there may be upheaval in one part and subsidence in another. Subsidence alone may produce an expansion of channel at its locus, and upheaval may hold the waters back and produce expansion of the stream above the locus of displacement. By either or both of these methods the channels of great streams are largely modified, and even lakes are produced thereby. And streams are ponded by still other agencies that need not here be described. Stream-reaches expanded in this manner become areas of deposition where waters are largely discharged of load. In such cases streams are deprived of the instruments of corrasion, and corrasion is checked to the extent to which this is true. It has been seen that steep local declivities are formed by indurated geological

formations and by affluent dams. The ponding of streams by diastrophic and other agencies tends to convert the rapids of such declivities into cataracts. The plunging waters checked at the foot of the declivity are loaded by the impact and thrown into gyratory movements, as currents and whirlpools, and corrasion is thus greatly intensified at that point; and when the stream above is deprived of its instrument of corrasion by ponding, the corrasion at the foot of the rapids is much more intense that at the head, and thus it is converted into a cataract. Where geological conditions for sapping are most favorable, that is, where the strata are approximately horizontal and composed of harder and softer material, the cataract condition is still further promoted. It is thus that heterogeneity of width increases heterogeneity of declivity.

When a stream deposits load, the place of deposit is governed by a great variety of conditions. First, reaches of low declivity are reaches of deposition, and in ponded reaches deposition is excessive; Second, alluvial dams are sites of deposition; Third, when a stream corrades vertically and cliff banks are sapped, the material is at once deposited; Fourth, when cliffs are formed by lateral corrasion in flood-terrains the load is carried down stream, but maximum deposition occurs at the first quiet water below; Fifth, deposition sites are often adventitious. The most common agency of this character exists in the flood-wood carried by the stream. A floating tree may lodge below a reach of great lateral corrasion at the head of a region of equilibrium, where there is no lateral corrasion, and near to one bank. The tree so lodged may gather other driftwood, and inaugurate deposition, so that a bank will be rapidly constructed and built up into an integral part of the terrain. By this agency the stream may be turned against the opposite bank, and a great river-curve with a radius of one or more miles may be established, and thus square miles of the flood-plain may be cut away through the accident of a lodging tree.

It has already been seen how increase of load transforms vertical corrasion into lateral corrasion. There are two noteworthy illustrations of this fact that may well be further explained. When the stream debouches from a mountain course of high declivity to a plain or valley course of low declivity, a part of its load is suddenly deposited, the channel is thereby choked, and vertical corrasion is transformed into lateral corrasion. The stream is thrown against one and then against the other bank, and a flaring gorge is produced with its opening to the valley side and its apex in the mountains or hills. At the same time a broad, over-placed deposit is made, called an alluvial cone or alluvial fan. In this case it will be seen that as vertical corrasion is transformed into lateral corrasion the total amount of corrasion is increased thereby.

The trunks of great streams often run in low valleys where the declivity is so slight that all corrasion is lateral. Here the load is deposited, not uniformly throughout the channel, but wherever there are reaches of quiet water. The deposition from the initial load becomes less and less down stream from place of deposit to place of deposit. At every place of deposit a bank or bar is formed, which progressively becomes an impediment to the stream and around which the stream is turned in a curve. As it is diverted from its course it strikes with force against the opposite bank, and into this bank it corrades. If the banks are but slightly coherent the stream is loaded again with new material. This is greatly increased when the banks are cut in such a manner that the method of degradation by sapping is initiated, and this sapping is itself made more efficient if there are permeable strata into which the water penetrates so as to assist in sapping. The new load taken on in this manner serves further to choke the stream as it adds to the deposits below. In this manner the stream is turned against its banks at comparatively short intervals, and every curve is increased. This agency for the increase of tortuosity is counteracted by three other conditions that arise. First, two contiguous curves in the same river may increase until they coalesce, and a cut-off is established; Second, the increasing tortuosity is increasing length, and increasing length produces decreasing declivity, and the local corrasion is diminished thereby; Third, as the river swings from bluff to bluff across its flood-plain, by lateral corrasion, it works the materials over and over again, and grinds and regrinds the materials composing the banks; so that in the general average, the alluvium of the lower reach of the flood-plain is more finely comminuted than the alluvium of the upper reach. For this reason the load which is added from time to time in the downward course of the stream is more and more comminuted. Flotation is thus promoted; that is, the particles are held in suspension longer. The effect of this is that the particles make longer excursions and therefore choke the river less, and gradually they are robbed of their power of inducing corrasion. For this reason, when all the conditions are present, rivers running through low flood-plains become less and less tortuous as they approach their outlets — a condition well illustrated by the Mississippi River between Cairo and the Gulf. This law of tortuosity is interrupted wherever a lateral stream brings coarse material into the reach subject to the law.

In a stream where corrasion is wholly vertical the deposited load is driven along the bottom and reloaded from time to time, and the channel is thus kept clear of fixed deposits; but when a lesser degree of declivity is reached, so that the deposits choke the channel and cause lateral corrasion, the several deposits remain for a time to be attacked by the stream, which shifts its channel gradually or abruptly, as the case may be. When the declivity decreases to such an extent that corrasion is wholly lateral, the deposits become more permanent. A deposit once made is protected by subsequent deposits, and the process continues until bars and banks are built up into integral parts of the alluvial terrain. By this process the stream is turned against some other portion of the terrain, and loads itself again with new material. In the vicissitudes of channel-cutting recent bars and banks may sometimes be destroyed, but very rarely. To a large degree the deposits become permanent obstructions, continually increasing, until the river is wholly turned out of its course. By this process the tortuosity is produced and the channel is made to wander back and forth through the flood-terrain. In one sense the whole flood-plain valley, or rather the channel occupied by alluvial terrain, is the channel of the stream, and is occupied in part by the river and in part by deposits.

In this connection these two laws may be formulated: (*a*) When sediment is deposited it ultimately causes other sediment to be loaded; (*b*) The wider the flood-plain in proportion to the volume of the water, the greater will be the average length of time through which each deposit remains in place.

The forces of degradation are established by nature, and in general cannot be increased or diminished by man, and he can only control their operation to a limited degree. All of the forces in hydraulic degradation are of vast magnitude, and are far in excess of the powers actually utilized in the production of results, and when man deals with them he deals only with conditions. To make this clear to the mind, some illustrations may be useful. The following may serve for this purpose. The flood-plain valley of the Mississippi from Cairo to the jetties is about 550 miles in length and about 49 miles in breadth; that is, it has an area of about 27,000 square miles. If this flood-terrain be estimated to have an average depth of 50 feet, it would give a geological formation of about 250 cubic miles, which is wholly alluvial.

The forces of erosion are chiefly found in the precipitation of rain and snow from the heavens, and in the changes of the temperature from hour to hour and from season to season. Now let us suppose that all these forces could be utilized in the erosion of the described Mississippi flood-terrain, as they are sometimes utilized in bad-land hills, then the rate of erosion would be enormously accelerated. To get a clearer conception of these conditions, suppose that the whole flood-terrain were built into a system of hills having the normal slope of loose earth, and that between the hills there existed a ramification of streams, as rivers, creeks, brooks, and rills, and that the whole region was sufficiently elevated above the sea to give these streams a rapid flow, and that the rainfall of the region remains the same as at present, and that there be no protection from vegetation or other agencies, — then the present rainfall would erode away the described flood-terrain in less than five decades. Such conditions are sometimes found in nature, though rarely.

Now let there be built up in the mind a possible rate of corrasion when the conditions for the highest rate are at a maximum. The Mississippi River has been known to cut its banks at the rate of a mile a month, and yet the river was not utilized to the extent of its power; in fact, but a modicum of its corrading energy was brought

into play. Using still the flood-terrain as above described, let it be supposed that the river is turned against it in such a manner that the whole mechanical energy of the stream is directed against it, and suppose further that as fast as the banks are torn down by the impact of the water and the sapping of the banks the material is promptly carried away through the agency of great declivity, then the whole terrain would be carried away in less than ten years.

Next, let the rate of transportation under maximum conditions be illustrated, and still let the described flood-terrain be used for this purpose. Suppose that the terrain could be loaded upon the Mississippi in such a manner that the waters are constantly supplied to their utmost capacity. Now it has been observed in Utah, and again in Colorado in the case of certain bad-land streams, that under most favorable conditions water is capable of transporting its own volume of load. The Mississippi River annually discharges into the Gulf an average of one million cubic feet per second. If this volume of water were loaded to its utmost capacity, as described above, the flood-terrain of the Mississippi would be discharged into the Gulf in one year.

The rate of corrasion is subject to many interdependent variable conditions, Only the laws of the first order have been presented. There is still a great number of conditions of a second order to be considered; but they do not in any material way vitiate the laws already stated. The facts and principles that have been presented are those which the engineer must use in planning and constructing irrigation works. They are also of importance in dealing with the regimen of rivers for the purpose of improving navigation, and for the still more important purpose of protecting flood-plains from overflow. It is proposed here to call attention to some of the engineering methods which have been used to control rivers for the protection of flood-plains. Those selected for mention in this manner are as follows.

The banks of the stream may be protected from lateral corrasion by revetment, but such protection will be sufficient only to the extent to which it is applied; for thorough protection both banks must be revetted throughout the whole length of the flood-plain reach. And further, the revetment must be carried below the level of possible vertical corrasion or the revetment will be undermined. By this method the channel is protected from the choking which arises from the deposition of materials brought in from upper reaches, lateral tributaries, and local erosion. In a bank-protected channel along a flood-plain reach there is a constant tendency to distribute the obstructing deposits evenly along the bottom, as the lower declivities are sites of deposits and the higher declivities present conditions of increased vertical corrasion. In a river with uniform channel and uniform volume of water the deposition is uniformly diminished from head to foot, and such a stream builds up its channel until a degree of declivity is reached sufficient to carry away all the supply of load. If the declivity is more than sufficient to carry away the load supply, vertical corrasion is inaugurated and the channel is deepened. If the declivity is insufficient to carry away the supply of load, the deposit of sediment will build up the channel, and destructive floods will be increased thereby. Revetment, therefore, is efficient only on the condition that the declivity is exactly sufficient to carry away the load and to produce no further corrasion; for if vertical corrasion be increased, the revetment will be undermined and destroyed, and if vertical corrasion is insufficient, deposits will be made and floods will result. The practical problem, therefore, is to decide whether the declivity is or is not sufficient to preserve the channel. This problem is always solved by nature, and its solution is made perfectly plain. If the declivity of the flood-plain reach is sufficient to preserve the channel, the channel will be preserved, and there will be no lateral corrasion. Every flood-terrain is such because the channel of the stream has an insufficient declivity for its own protection. The very fact that corrasion is wholly lateral is in itself an absolute demonstration that the declivity of the stream is insufficient for the protection of the channel. This arises from the fact that the load once deposited remains, as the channel does not present conditions for its reloading: revetment, therefore, is necessarily futile, except for local and temporary purposes.

If portions of the banks of a channel are revetted, the only result arising therefrom is to change the locus of lateral corrasion; for, the total deposits remaining the same, the total lateral corrasion will remain the same. If the whole channel is revetted, the whole channel will be built up thereby, and ever a greater volume of water will be distributed over the flood-plain, until the channel is entirely filled at its head, or built up to such a declivity that vertical corrasion will be sufficient to preserve the channel.

There are four other methods that have been presented by engineers and geologists still worthy of consideration, as they are more or less efficient, either separately or conjointly. These are as follows.

1. The channel of the stream may have its banks and bars removed, and it may be deepened by river ploughs. To be efficient, the clearing of the channel of its deposited obstructions must be complete. The effect of clearing a lower reach is not extended to an upper reach, but the effect of clearing an upper reach is to increase the obstructions of the lower. For this reason the channel must be cleared its entire length throughout the region to be protected from floods at one effort.

2. The channel of the river may be shortened. By this method the declivity of the stream will be increased, the velocity of the current increased, and the waters more rapidly discharged. At the same time the channel of the stream will be deepened progressively from the foot to the head of the reach, where the stream runs through alluvial formations; but wherever the stream has its bed in indurated rocks the progress of stream deepening will be retarded.

The shortening of the channel may be accomplished by two methods.

a. By establishing a nearer outlet.

b. By utilizing and promoting cut-off reaches.

3. The headwaters and tributaries may be impounded in reservoirs at flood time and held until low water, and the volume through the year may thus be more or less equalized.

4. The headwaters and tributaries of a river may have their waters drawn off into settling basins, and thus they may be caused to discharge the sediment they carry, which is the material which forms the deposits and chokes the channel, and also the instrument of lateral corrasion.

It is manifest that the storage of water and the discharge of sediment may be accomplished by the same agency.

It is the purpose here merely to mention the principal efficient methods of controlling rivers in their flood-plain reaches. Every river presents problems more or less peculiar to itself, and the application to special cases of the laws which have been set forth is one of great interest and of profound importance.

J. W. POWELL.

COMMERCIAL GEOGRAPHY.

The Care of our Forests.

IN the annual report of the Department of Agriculture, B. E. Fernow, chief of the forestry division, dwells most emphatically upon the necessity of adopting a sound policy regarding our forests. His interesting report is accompanied by a map showing the distribution of forests in the Rocky Mountains, where they serve the important purpose of regulating the flow of springs and streams. Mr. Fernow's weighty arguments and urgent demands for better care of our forests ought to attract the most speedy attention of our legislators. He says, —

"It has become evident, in spite of the enormous supplies which seemed to be available, that our natural forests are being rapidly reduced, both by an increased demand and by wasteful practices; and it is now safe to say that the annual consumption of wood and wood-products is at least double the amount reproduced on our present forest area. The forest, under proper management, is capable of furnishing continuous crops, and therefore, as a source of constant supply, demands national legislation.

"It has become evident, that with the unrestrained scourge of fire and the destruction by herding, and other malpractices now prevalent, and in the absence of all rational forest management, not only is the remaining forest deteriorated in material value, but large tracts of land are converted into absolute deserts or useless bar-

rens. A sound land-policy, therefore, demands that the nation should give earnest attention to forest management.

"It has become evident that we are not to escape the consequences of disturbing the even distribution of water-flow by forest devastation, and denudation of mountains and hills, which have been experienced in other parts of the world, and which have reduced fertile lands to barrenness, prosperous communities to poverty. Regard, therefore, for the future welfare of the several communities which in their aggregate represent the nation, calls for a rational forest policy, a proper utilization, a proper distribution, and a proper management of the natural forest.

"Lastly, if the nation as such is interested in the proper development of the rich agricultural lands of the plains and prairies, it must be interested also — in that part of its domain, at least — in forest-planting as a means of ameliorating climatic conditions and making the region more habitable."

Mr. Fernow then proceeds to consider the most immediate needs and the most immediate duty of the general government in regard to the forestry question. "The general government still holds, as an individual, national property, a forest area the extent of which is unknown, but may be estimated between fifty and seventy million acres. The bulk of these lands is to be found on the rugged mountain sides and crests of the Western ranges, notably the Rocky Mountain, Cascade, Sierra Nevada, and Pacific coast ranges, mostly land not fit for agricultural use. The agricultural valleys at the foot of these ranges are not only destitute of timber, but they are dependent for their agricultural productions upon irrigation, the water for which is derived from the mountain-streams and more rarely from artesian wells, both of which sources are fed by the rains and snows which fall upon the forest-covered mountain-sides, and gradually find their way to the plain below. It has been proved not only by experience, but by actual experiment on a large scale, that forest cover regulates and beneficially influences the rapidity with which these precipitations are carried to the plain for utilization on agricultural lands."

In order to preserve these woods, a bill has been formulated, which has been submitted to Congress through the agency of the American Forestry Congress. Its essential features are the withdrawal from sale, or other disposal, of all woodlands still in the hands of the government, and the classification of the same into three classes; the regulation of the sale of timbered land which is fit for agriculture; and the management of the forests occupying land unfit for agriculture. To insure a proper administration of such a law, to prevent waste and loss by fires, a new bureau in the Department of the Interior is proposed, with a forest commissioner and four assistant commissioners acting as a forestry board.

"None but such a thorough organization can be expected to guard the national property, of which, under the present neglect, the nation is annually robbed to the extent of from five to ten million dollars, not counting the damage done by fires and fraudulent operations of speculators. But, as has been stated repeatedly, the forest-cover in the localities in which the bulk of the public timber-lands is situated, notably on the Rocky Mountains and the Pacific slopes, subserve a function which makes its material value of only secondary importance. It has become already evident that the denudation of mountain-sides in the region under consideration has impaired the regularity of water-flow, upon which irrigation in the arid valleys below depends.

"The interest of the nation, therefore, in properly administering this property, reaches beyond that of any material advantage; and certainly in these mountain forests, in this legislation for their proper administration, lies the immediate national interest in forestry."

ELECTRICAL SCIENCE.

The Heroult Aluminium Process.

THE Swiss Metallurgical Company, established close to the Rhine Fall at Neuhausen, has adopted the process of M. Heroult for the production of alloys of aluminium. The process resembles in some ways that of the Cowles brothers, which is so successfully employed at Lockport in the United States, and which has been recently introduced in England and the continent. In both the Cowles and Heroult processes an electric current is employed. In the former it is used simply to produce a very high temperature in a limited zone, the reduction of the ore being due to the temperature alone and not to any effect of electrolysis, so that an alternating could be used as well as a continuous current. In the Heroult process, according to the views of the inventor, the reduction of the ore is partly electrolytic and partly due to the heat of the arc. The furnace has a carbon pole at the top, and the current passes in by it through the melted aluminium oxide to the reduced metal at the bottom; the ore is decomposed, the oxygen passing upward and attacking the carbon, while the molecules of the metal travel downward and are merged in the metal bath.

The furnace used in the process is a large carbon block hollowed out in the proper shape and enclosed by a frame of iron. In the smaller furnaces a single block of carbon is used and the iron is cast around it; for larger sizes slabs of carbon are used, and are held together by wrought-iron bands. There is an opening in the bottom of the furnace for drawing off the reduced metal. The current enters the crucible through a carbon electrode which enters the top, and which consists of a bundle of carbon slabs, ten feet long, seventeen inches wide, and nine and a half inches deep. The distance of this electrode from the surface of the molten metal is regulated by an attendant. This distance is very small, preferably not over a quarter of an inch. One of the electrodes is consumed in producing about half a ton of aluminium. The crucible is covered by carbon slabs insulated from the body of the crucible; in the top, holes are provided for the introduction of ore and scrap metal. The ore generally used is alumina, free from silicon and other impurities, and the scrap metal is either iron or copper, according to the alloy which is desired. The process of smelting is a continuous one, the ore being introduced and the crucible tapped at regular intervals. The production of aluminium per horse-power hour varies somewhat with the percentage of the metal contained in the alloy, the average being thirty grams of aluminium and the maximum being forty grams. That is, to produce one pound of aluminium requires fifteen horse-power hours on the average, and eleven horse-power hours under favorable conditions. The present capacity of the crucible is four hundredweight of aluminium in twenty-four hours.

At the works at Neuhausen the current is produced by two dynamos driven by a turbine of three hundred horse-power. These dynamos are of the multipolar type, designed by Mr. C. E. L. Brown, and built at the Oerlikon Engineering Works. They are designed to give six thousand ampères each, at an electromotive force of twenty volts, and they can be worked up to thirty-five volts. The speed of the turbine is controlled by an automatic regulator acting upon a throttle in the inlet-pipe of the turbine. While the working current is normally twelve thousand ampères, it sometimes increases to twenty thousand ampères, because of a short-circuit in the furnace, caused usually by one of the slabs of which the carbon electrode is made burning more slowly than the others and touching the surface of the molten metal. This increase of current does not injuriously affect the dynamos. There is no sparking at the brushes of the dynamos. The process promises to be a successful one; from the figures given it compares favorably with the Cowles process in the amount of aluminium reduced per horse-power.

AN IMMENSE ELECTRIC LIGHTING STATION. — In the London *Electrical Review* is a description of the station of the London Electric Supply Corporation. At the Stowage wharf, Deptford, this corporation is laying down plant sufficient for the supply of 250,000 incandescent lamps, and there is space for three other sets similar to the first, giving a final capacity of one million lamps. The grounds of the corporation have a river frontage, with a wharf for landing fuel and heavy machinery. A fifty-ton derrick has already been erected. The buildings occupy a space of 210 by 195 feet, and the height will be 100 feet.

The boiler house is 195 by 70 feet, and is constructed to hold boilers of 65,000 horse-power, and of these, 13,000 horse-power are being erected. The boilers will occupy the two lower floors, with stowage room above for the fuel. The two engine houses are of nearly the same dimensions as the boiler house, and are very massive in construction. In the first of these houses a pair of 3,000

horse-power engines will soon be erected, and will drive two Ferranti dynamos, each capable of supplying current for 25,000 lamps. These are the largest electric generators in the world, and we can get some idea of the increasing size of dynamos when we remember that four years ago the largest practical machines were Edison's 'Jumbo' dynamos of 1,200 lights capacity. In the second engine room will be placed two sets of engines and dynamos. These are combined in such a manner that the armatures of the dynamos are driven directly by the engines and act as their fly-wheels. The speed is but sixty revolutions per minute. There will be four dynamos, and they will finally have each a pair of 10,000 horse-power engines. At present they are to have but 5,000 horse-power each. All future extensions of plant will be in these units. The dynamos will weigh 500 tons, and the armatures will be 45 feet in diameter.

The distribution will be on the alternating current system. The current leaves the station at the enormous potential of 10,000 volts, and is taken to a number of distributing stations where a first conversion takes place, lowering the potential to one or two thousand volts; then it is taken to the points of consumption, where a second conversion takes place and the voltage is lowered to that necessary for the lamps.

The main cable, $2\frac{5}{8}$ inches in external diameter, is formed of two concentric tubes of copper. An insulating compound separates the two tubes, the central portion of the cable being hollow: the sectional area of each tube is .5 of a square inch.

The first two dynamos of 1.500 horse-power each are nearly completed, and will soon be erected; two of the 10,000 horse-power dynamos will probably be finished in about five months. The space now covered with buildings will accommodate 40,000 horse-power, and the rest of the space available can accommodate 80,000 horse-power more, a total capacity of 120,000 horse-power.

This station, in capacity and the enormous potential used (the maximum electromotive force is about 15,000 volts), far surpasses any thing that has been attempted in this country or anywhere else. It is hardly to be hoped that the scheme will succeed without great trouble and discouragement at first, since many of the conditions are new; but whether it finally fails or succeeds, the experience it will give will be of great benefit to electricians.

ELECTRO-DEPOSITED COPPER. — Messrs. Elmore, in England, have introduced a process for the production of pure copper tubes, wire, etc., by which very satisfactory results have been obtained. The general method of producing a tube is to immerse a revolving mandrel, nearly surrounded by bars of Chili copper, in a bath of copper sulphate, and send a current of electricity between the bars and the mandrel. The ordinary result would be the deposition of crystalline copper, with little adhesiveness and strength. The essential feature of the process is a burnisher pressing lightly on the surface of the copper, travelling on a leading screw from one end of the mandrel to the other, its motion being automatically reversed when it reaches either end. The result is a tube of great density and strength, and without lines of weakness as in ordinary tubes.

When it is desired to make wires, tubes of any desired length and thickness are cut spirally into square wires, and these are afterwards drawn to the required size and shape. The conductivity is greater than that usually obtained in commercial wire, and is even greater than that of the samples determined by Dr. Matthiessen, who used the greatest care in obtaining his specimens of copper. Tests made on annealed and hard-drawn wires give respectively 102.4 and 104.44 per cent of the conductivity obtained by Dr. Matthiessen for pure copper.

BOOK-REVIEWS.

Researches on Diamagnetism and Magne-Crystallic Action. By JOHN TYNDALL. New York, Appleton. 12°. $1.50.

WHEN Tyndall undertook the first of the researches contained in this volume, the attention of physicists had been drawn to the remarkable phenomena exhibited by certain substances, metals, and other matter, and by crystals when placed in a magnetic field. It was found that various substances, notably bismuth, were repelled by magnetic poles instead of being attracted; and it was stated that crystals in a magnetic field tended to take up a definite position, but were neither attracted nor repelled. With respect to the first of these phenomena, the questions which arose were, 'What is the nature of this diamagnetic force?' 'Does it correspond to magnetic force but with an opposite direction?' Faraday first thought that the phenomena might be explained by assuming in diamagnetic bodies a polarity the reverse of that in magnetic bodies; but he soon abandoned this view, and held that the apparent diamagnetism of bodies was caused by their being less magnetic than the medium in which they were placed. A diamagnetic body was with him a body less magnetic than air.

Tyndall, in these memoirs on the subject, has with great ingenuity, and with apparatus at once powerful and delicate, compared the deportment of diamagnetic with magnetic bodies; and "the antithesis between them, when acted on by all possible combinations of electro-magnets and electric currents, was proved to be absolute and complete. . . . No reasonable doubt, therefore, could rest upon the mind that the diamagnetic force possessed precisely the same claim to the title of polar force as the magnetic."

This work of Tyndall's was done over thirty years ago. The attention of physical scientists was called to other electrical and magnetic phenomena, and no really important experiments on magnetization were tried until 1872, when Stolltow and Rowland published their well-known researches. But in the last few years interest has again centred in magnetic phenomena, and it is well that attention should be called to earlier experiments.

The present edition of 'Diamagnetism and Magne-Crystallic Action' differs from the original in the omission of some parts that are of little interest now. As a clear description of difficult, ingenious, and successful experiment, it should form part of the library of every physicist.

Tales of the Birds. By W. WARDE FOWLER. London and New York, Macmillan. 12°. $2.50.

THIS book is hard to classify, being a series of eight fancy sketches, consisting of imaginary bird-talk, with little obvious point, and containing little that can be seriously called ornithological. It is designed, perhaps, to illustrate certain incidents of bird-life, as the hard struggle for existence of English field-fares in winter, the dangers and mishaps befalling birds during migration, etc. The birds are supposed to tell their own tales. The slight web of fact is heavily padded with light fancies, designed doubtless to interest especially juvenile readers, who may find the book somewhat attractive. The book is English in its scenes and subjects. The writer is obviously familiar with bird-ways, and might write well in a more serious vein. The eight full-page illustrations are quite in keeping with the general character of the text. The title of the book is about all that would suggest its classification as a natural-history publication.

A Manual of the Vertebrate Animals of the Northern United States. By DAVID STARR JORDAN. 5th ed. Chicago, A. C. McClurg & Co. 12°. $2.50.

THE present edition of President Jordan's well-known 'Manual' is much enlarged in scope, and so completely rewritten and re-arranged as to be in many respects not only greatly improved, but practically a new work. The geograpical area is extended westward from the Mississippi River to the Missouri River, and the marine forms (excluding the deep-sea species and those of merely accidental occurrence) are for the first time included, the coast region thus covered extending from Nova Scotia to Cape Hatteras. The artificial keys of the former editions have in great part given place to analytical keys based on differential characters. While this change may render slightly more difficult the quick recognition of species by the inexperienced student, it has the advantage of making known more clearly the actual basis of classification. The order of succession of groups is also reversed, the lowest or more generalized standing first; the 'Manual' beginning with the fishes, and ending with the mammals. By the omission of synonymes and references, except in special cases, the use of smaller type and a larger type-bed, the amount of matter has been much increased, while the number of pages is lessened and the typographical appearance of the book greatly improved. In classification and nomenclature the work is fully abreast of the latest discoveries and conclusions in respect to

each of the classes treated. With its enlarged scope, more extended diagnoses, and improved keys, the 'Manual' must now prove even a more efficient and satisfactory aid to both student and teacher than heretofore, and prove fully worthy of the extended patronage it is sure to have.

Hygiene of the Nursery. By LOUIS STARR. Philadelphia, Blakiston. 8°. $1.50.

OF the many books which have been published on this subject, the one now before us is by far the best. The plan of the author has been to point out a series of hygienic rules, which, if applied to the nursery, can hardly fail to maintain good health, give vigor to the frame, and so lessen susceptibility to disease. He has done his part well, and if he shall receive the co-operation of the mothers and of the physicians, his self-appointed task cannot but result in much good everywhere, and, in many families, in a complete revolution. While Dr. Starr has evidently had especially in mind, in the preparation of this manual, the mother and the nurse, his book is one which every physician should possess. In the opening chapter the author describes the "features of health," by which term he refers to the evidences which healthy children manifest of their well-being. Of these, every mother should have a full knowledge; so that, by appreciating variations, she may anticipate the complete development of disease, and early summon skilled aid at the time when it is of most service. In speaking of the nursery, Dr. Starr says that in every well-regulated house in which there are children there should be two nurseries, — one for occupation by day, the other by night, — and that the best and sunniest rooms should be selected. The size, lighting, furnishing, heating, and ventilating of the nursery are described in detail. The qualifications of the nurse-maid are mentioned, and the author then passes on to the kind of clothing which children should wear at different periods of life. Separate chapters are devoted to exercise and amusements, sleep, bathing, food, dietary, and emergencies. We are glad to see that Dr. Starr condemns the rubber and glass tubing in connection with the nursing-bottle. He speaks of these appurtenances as "not only an abomination, but a fruitful source of sickness and death." His language is none too strong. Physicians and others connected with dispensaries and summer homes for sick children regard these tubes as intimately connected with the production and continuance of bowel-troubles, and begin the treatment of such cases by discarding the tube, and substituting a simple rubber nipple. The reason for this is, that these tubes cannot be cleansed, and the milk which passes through them becomes decomposed, and contaminates all the milk which subsequently is drawn from the bottle by the child. In the chapter on emergencies, the immediate treatment of bruises, sprains, fractures, cuts, burns, scalds, stings of insects, foreign bodies in the ear, eye, nose, and throat, ear-ache, nose-bleed, colic, and convulsions, is described, as is also the method of disinfection after contagious diseases. Taken as a whole, Dr. Starr has given the public an exceedingly practical, and therefore valuable book. His language is simple, and devoid of technicalities, and there is no portion of it which cannot be readily understood by every intelligent person.

Names and Portraits of Birds which interest Gunners, with Descriptions in Language understanded of the People. By GURDON TRUMBULL. New York, Harper. 12°.

IN some respects Mr. Trumbull's book covers new ground, its two chief objects being to provide gunners with plain, non-technical descriptions and simple black-and-white figures (woodcuts) of the birds in which they are interested, and an elucidation of the vernacular names applied to our game-birds. This latter is perhaps the true *raison d'être* of the work. The labor and time the author must have given to this phase of the subject are evidently very great, and the results are of much interest, as well as of practical utility, not only to gunners and sportsmen, for whom the work is primarily intended, but for ornithologists and philologists as well. The quaint title very fully expresses the scope and purpose of the work. The number of species treated is sixty-one, of which more than half are ducks and geese, five are members of the rail family (*Rallilæ*), nine are shore-birds, plovers and sandpipers, and five are grouse. Each species, including its various phases of plumage, is described fully in "language understanded of the people." He says, possibly with some truth, "Few, even among our most intelligent college-bred sportsmen, can form a clear idea of a bird's appearance from the 'shop-talk' of scientists, even though provided with a glossary."

About ninety very beautiful woodcuts, drawn by the well-known bird-artist, Edwin Sheppard of Philadelphia, effectually supplement the text; figures of both male and female being given, when, as among the ducks, the sexes greatly differ in plumage. The technical names are those of the American Ornithologists' Union 'Check-List of North American Birds,' and the habitats are usually given from the same source.

The greater part of the text is devoted to the common vernacular names of the various species treated, little being said about habits. While synonymy is such a bane and burden in scientific literature, Mr. Trumbull's book shows that in the case of vernacular names, which our author so delightingly collates, the number and complexity of aliases are far greater, and the unravelling of the tangled skein much more difficult; "so many names being used for more than one species, and so many having been given to one and the same bird." The pintail duck (*Dafila acuta*), for example, rejoices in thirty-one distinct English aliases, not counting numerous simply orthographic variations; while the surf scoter (*Oidemia perspicillata*) and the old squaw (*Clangula hyemalis*) have respectively thirty-three and thirty-four distinct vernacular designations. Half that number is about the rule, while the ruddy duck (*Erismatura rubida*) heads the list with *sixty-seven!* Many of these names are extremely local, and the author does well to give explicitly the localities where they are in use. "The principal reasons for this multiplication of names are obvious: viz., differences in size, shape, and color between males and females; periodical changes in plumage; mistaking one variety for another; and, more particularly, differences of opinion as to the names most appriate." In some instances a whole set of names is based on each striking feature of the bird, as of the bill or tail, or on coloration, or on peculiarities of habits. "Many of these names probably appear now for the first time in print, yet few are of recent origin; and, though some may be a little time-worn, they are time-honored, and as familiar in certain localities as 'cow,' 'dog,' and 'cat.' . . Names which appear to us absurdly grotesque and outlandish are mediums of communication between men as wise as ourselves, though educated in a different school; and the homely nomenclature of those who shoot, not alone for sport, but for their daily bread, should command respect." As already said, Mr. Trumbull's book is especially interesting from the standpoint of philology, as showing how words originate and language grows.

A very full index completes this admirable work; but a table of contents, giving lists of the species treated and of the illustrations, would also have been of great convenience.

Essays on God and Man, or a Philosophical Inquiry into the Principles of Religion. By HENRY TRURO BRAY. St. Louis, Nixon-Jones Printing Co. 12°. $2.

THIS work is written by an Episcopal clergyman of Missouri, and deals with the bearings of evolutionism and other scientific theories of the present day on the accepted doctrines of religion. The author is clearly imbued with both the religious and the scientific spirit, is thoroughly in earnest, and writes for the most part in perfect good temper. Sometimes his repugnance to certain superstitions that have gathered around Christianity leads him to use expressions that are a little rough, and those parts of the book might better, perhaps, have been omitted, as the doctrines thus attacked have already lost their hold upon thinking minds; but on the whole the tone of the work is excellent. The style, also, is simple and clear, and never leaves us in doubt as to the author's meaning. Mr. Bray's religion is based upon scientific doctrines on the one hand, and, on the other, upon all that is best in the religious teachings of the whole world. He maintains that the science of the present day is religious, and gives some quotations from scientific writers in proof of this assertion. He holds strongly to the evolution philosophy, though believing that we can know more of the divine attributes than most evolutionists admit; and he defines God as "universally extended Conscious Force." He re-

jects the doctrine of inspiration as heretofore taught, and maintains that all scholarly theologians do the same. A religion in harmony with science may, he thinks, be founded on the following doctrines: "1°. There is an Infinite Intelligence whom we call God; 2°. Man is by nature a religious being; 3°. Every religion has in it a nucleus of truth; 4°. No religion is exclusively true or founded upon an exclusively divine revelation." Christianity, however, is regarded as the best of all religions, and as the "highest outcome of human nature." Mr. Bray quotes many passages from non-Christian religious writers, including the Greek philosophers, the authors of the Vedas, the Chinese moralists, and many others, in support of his positions; and these quotations form an interesting portion of the book. On the subject of immortality the author speaks with hesitation, presenting the arguments on both sides, and drawing the conclusion that there is ground for hope but not for dogmatizing. Our readers will see that there is nothing essentially new in these views; but as coming from a clergyman, and addressed to a congregation of the people, — for they were originally presented in public lectures, — they have considerable interest, and Mr. Bray's book will well repay perusal.

A Text-Book of Euclid's Elements. By H. S. HALL and F. H. STEVENS. London and New York, Macmillan. 12°. $1.10.

THIS volume contains the first six books of Euclid's elements, together with appendices giving the most important elementary developments of Euclidean geometry, The text has been carefully revised, and special attention given to those points which experience has shown to present difficulties to beginners. The authors have been guided in part by the suggestions contained in the text-book of the Association for the Improvement of Geometrical Teaching. The propositions are throughout treated very fully, and the authors have avoided condensing two or more steps into one. In this they were guided by the weighty consideration that only a small proportion of those who study elementary geometry, and study it with profit, are destined to become mathematicians. To a large majority of students, Euclid is intended to serve not so much as a lesson in mathematical reasoning, as the first, and sometimes the only, model of formal and rigid argument presented in an elementary education.

NOTES AND NEWS.

THE Christmas number of *Scribner's Magazine*, which completes its second year, will contain a variety of articles in prose and verse, especially suited in sentiment and illustration for the holiday season. There will be twenty full-page pictures, and many others from drawings by such artists as Elihu Vedder, J. Alden Weir, W. Hamilton Gibson, Bruce Crane, and Robert Blum. The art of making stained-glass windows, which has had its renaissance in this country within the last twelve years, will be the subject of a paper by Will H. Low; the third and concluding instalment of Lester Wallack's reminiscences will appear; George Hitchcock (the artist, whose picture, 'The Tulip Garden,' in the Paris salon of 1887, made his reputation) has written and illustrated for the number a short paper on 'Sandro Botticelli,' as 'the man who, above all others, gave an impulse in the right direction to the new art of the Christian world,' and Elihu Vedder has illustrated a strikingly original anonymous poem which will, it is believed, excite considerable curiousity as to its authorship. —— *Treasure Trove* for November opens with an illustrated account of the Lick Observatory, followed by articles on the Wilkes-Barre accident; the Canadian fish question; the disagreement of the doctors; the Chicago riots; and the wheat corner, under the caption 'Is that the Law?' by Wolstan Dixey; 'Yellow Fever,' by W. H. H.; 'A Famous Astronomer,' with portrait of the late Richard A. Proctor; 'American Politics,' by Oscar R. Hart; 'Getting Ready for Christmas,' with illustrations, by Lucy Clarke; 'Russian-America' (second paper), illustrated. Besides this are illustrated papers on 'Mary Stuart,' by J. R. D. L.; 'Crystals,' by Margaret E. Houston; 'Children's Lunches;' 'The Metal of the Future;' 'What Congress Costs,' and others. —— A new edition of Browning's Educational Theories, with a complete analysis, a new index, and an appendix on the 'American Common School,' will be issued at once by E. L. Kellogg & Co., of New York and Chicago. Also Dr. Nicholas Murray Butler's 'The Argument for Manual Training,' and a new edition of Perez's 'First Three Years of Childhood.' G. Stanley Hall says of this last book, "I esteem the work a very valuable one for primary and kindergarten teachers and all interested in the psychology of childhood." ——The first step in avoiding mistakes is to find out how we fall into them. Valuable aid in this direction will be furnished in Prof. Joseph Jastrow's paper on 'The Psychology of Deception,' which will open the December *Popular Science Monthly*. As illustrations of his subject the author cites the tricks practiced by conjurers, and the delusions which from time to time gain a hold on the public mind. 'Infant Mortality and the Environment' is the subject of an article which J. M. French, M.D., will contribute to the same magazine. Dr. French points out the chief causes of infant mortality, which are due partly to heredity and partly to the surroundings. Finally 'Beliefs About the Soul' is the title of an article by R. A. Oakes. It is full of traditions of civilized and savage peoples, relating to immortality and to plurality of souls. —— Ticknor & Co. will publish this month 'Better Times,' a volume of stories by the author of 'The Story of Margaret Kent,' 'The Philistines,' by Arlo Bates; 'Pen and Powder,' by Frank B. Wilkie, of the *Chicago Times*, a series of monographs on the late war in the West; 'Vagrom Verse,' by Charles Henry Webb (John Paul), a collection of poems, pathetic and humorous, in illuminated vellum covers: 'The Other Side of the War — with the Army of the Potomac,' letters from Headquarters of the United States Sanitary Commission during the Virginia campaign of 1862, by Katharine Prescott Wormeley, issued under the auspices of the Massachusetts Commandery of the Military Order of the Loyal Legion. Miss Wormeley, now so well known as the translator of Balzac, was a prominent worker in the Sanitary Commission, especially in the Peninsular campaign. They will also publish 'Wanderers,' being a collection of the poems of William Winter, author of 'Shakespeare's England,' etc., and dramatic critic of the *New York Tribune*. —— Elizabeth Robins Pennell, wife of Joseph Pennell of Philadelphia, and his companion through Europe on a tricycle, will have a paper on 'Wells and its Cathedrals,' in the December number of the *Magazine of Art*. In this same issue will be the first of two papers on the 'Portraits of Dante Gabriel Rossetti,' by Wm. M. Rossetti. The portraits of the poet-painter in this number cover the period from his sixth to his twenty-fifth year, and are by himself, Holman Hunt, John Hancock, J. E. Millais, and others. —— Ginn & Company announce 'Analytic Geometry,' by A. S. Hardy, Professor of Mathematics in Dartmouth College, and author of 'Elements of Quaternions;' to be published in January, 1889. This work is designed for the student, not for the teacher. Particular attention has been given to those fundamental conceptions and processes which, in the author's experience, have been found to be sources of difficulty to the student in acquiring a grasp of the subject as a method of research. The limits of the work are fixed by the time usually devoted to analytic geometry in our college courses by those who are not to make a special study in mathematics. The same firm also announce 'The Beginner's Book in German,' by Sophie Doriot, author of 'The Beginner's Book in French,' to be published Jan. 1, 1889. This follows the natural method. The lessons are introduced with a humorous picture followed by some corresponding verses from the child-literature of Germany. A conversation upon the subject, with the study of words and phrases, completes the lesson. The second part contains graded selections for reading. They have in preparation 'A Reader in Botany,' for school use, selected and adapted from well-known authors by Jane H. Newell. ——In the *Edinburgh Review* for October is a graphic description of a tornado and its effects. —— D. Appleton & Co. will publish this week in their International Educational Series, 'Memory — What it Is and how to Improve it,' by David Kay; 'Astronomy with an Opera-Glass,' a popular introduction to the study of the starry heavens with the simplest of optical instruments, with maps and directions to facilitate the recognition of the constellations and the principal stars visible to the naked eye, by G. P. Serviss; also, new editions of Drs. Lindley and Widney's 'California of the South,' and of Edna Lyall's 'Donovan.'—— Roberts Brothers will publish on the 15th 'The Man without a Country,' by Edward Everett Hale, with forty illustrations by F. T. Merrill; 'The Pil-

grim Scrip, or, Wit and Wisdom of George Meredith,' with selections from his poetry, a critical and biographical introduction, and a portrait; 'Counter Currents,' a new story by the author of 'Justina;' and a cheap edition of Shakespeare's complete works, from the text of Rev. Alexander Dyce, in seven volumes with memoir, glossary, and portrait. They have in preparation 'Jane Austen,' in the Famous Women series: 'Ethical Religion,' by William Macintyre Salter; and 'Sunday-School Stories on the Golden Texts of the International Lessons for 1889,' by Rev. E. E. Hale. —— *Wide Awake* for 1889 promises to make an unusually bright and interesting volume. Serials by H. H. Boyesen, J. T. Trowbridge, Susan Coolidge, Sidney Luska, and other notable writers are promised, as well as short stories and timely articles by John Strange Winter, author of 'Bootle's Baby,' Andrew Lang, Jessie Benton Fremont, John Burroughs, Gen. O. O. Howard, E. S. Brooks, and others. Mrs. Deland's 'John Ward, Preacher,' is in the twelfth thousand. —— Mrs. Burnett's 'Little Lord Fauntleroy' has reached its sixtieth thousand. —— A. D. F. Randolph & Co. will publish on the 25th inst. 'The Thumb Bible,' by Bishop Jeremy Taylor. —— Rand, McNally & Co. will publish at once 'The Blackhall Ghosts,' a story by Sarah Tytler (Henrietta Keddie). —— The American News Company will publish this month a story entitled 'The Curse of Marriage,' by Walter Hubbell. —— Charles W. Sever, of Cambridge, Mass., will publish on Dec. 1, 'Hesper,' an American drama, by William R. Thayer, author of 'Confessions of Hermes.' —— The Forest and Stream Publishing Co., New York, have just issued 'Bird Portraits for the Young,' the text by Dr. W. Van Fleet and the photogravure plates by H. H. Darnell. —— Dr. M. L. Holbrook, 25 Bond St., New York, will publish on the 20th inst. a work entitled 'Eating for Strength, or, Food and Work and their Relation to Health and Strength.' The author is Dr. Holbrook himself, who in this book gives 500 recipes for wholesome foods and drink. —— Macmillian & Co. will publish shortly the second series of Matthew Arnold's 'Essays in Criticism,' selected by himself just before his death. The subjects are 'The Study of Poetry,' 'Milton,' 'Gray,' 'Keats,' 'Wordsworth,' 'Byron,' 'Shelley,' 'Tolstoï,' and 'Amiel.' Lord Coleridge contributes a prefatory note to the volume. —— Dodd, Mead & Co. announce 'Musical Instruments and Their Homes,' with nearly 300 illustrations, to be published in very handsome form. The work will comprise a complete account of the collection of musical instruments now in the possession of Mrs. John Crosby Brown of New York City. Mrs. Brown and William Adams Brown have written the letter-press. The work will be of interest to students of music as well as to ethnologists. —— Charles Scribner's Sons have in preparation a second, and probably final, collection of the poems of Mr. R. H. Stoddard. It will be entitled 'A Book of Verse: Early and Late,' and will contain a reproduction of the latest portrait of this versatile writer by Mr. George B. Butler. —— W. R. Jenkins has just ready, 'Le Second Livre des Enfants,' by Paul Bercy; 'Lameness of Horses and Diseases of their Locomotary Apparatus,' by Dr. A. Liautard; and an American edition of Strangeway's 'Veterinary Anatomy,' revised by I. Vaughan. He will publish late this month or early in December 'A Veterinary Diary for 1889,' with diary leaves for memoranda and a compendium of doses; also, a work on the 'Roaring of Horses,' by Dr. George Fleming, who has given special attention and study to this particular disease. —— Cassell & Co. will publish at once George Manville Fenn's new work, 'Commodore Junk,' an adventure story dealing with buccaneering life on the West Indian Main in the days of George I. They will also publish at once Walter Crane's new colored picture-book under the title of 'Flora's Feast: a Masque of Flowers.' —— A prospectus has been issued for a 'History of Book Printing in Vienna, from 1482 to 1882.' It is intended as a souvenir of the great celebration held in the Austrian capital in 1882, on the occasion of the four hundredth anniversary of the introduction of printing into Vienna. The compilation will be by Dr. Anton Mayer; the printing by Friedrich Jasper; Wilhelm Frick will be the publisher. The work is to be in two volumes of royal quarto, with illuminated initials, and illustrations in the highest style of modern art. —— Macmillan & Co. will publish before the close of this year 'The Recluse' (hitherto unpublished) of Wordsworth. The poem will also be included in a one-volume edition of Wordsworth's poems, which will contain all the copyright notes and prefaces. This edition, which will be uniform with the popular edition of Lord Tennyson's poems, will thus be the only complete edition in the market. At about the same time Messrs. Macmillan will issue under the title, 'Wordsworthiana,' a volume of papers selected by Professor Knight from those read before the Wordsworth Society. Among the contributors are Matthew Arnold, Lord Coleridge, Lord Houghton, Mr. Hutton, Mr. Aubrey de Vere, Mr. Lowell, Canon Ainger, Mr. Shorthouse, and the editor. —— *The American Journal of Archæology*, Vol. iv., No. 3, contains 'The Relation of the Journal to American Archæology,' by the editors; 'Antiquities of Southern Phrygia and the Border Lands,' by W. M. Ramsay; 'The Ancient Coinage of China,' by W. S. Ament, missionary to China; 'Gargara, Lamponia, and Pionia, Towns of the Troad,' by Joseph Thacher Clarke; 'The publications of the German Archæological Institute,' by Charles Eliot Norton; 'The American School of Classical Studies at Athens,' by the editors; 'Publication of Inedited Documents.'

— An elaborate historical work — somewhat similar in scale to that of Mr. H. H. Bancroft for the Pacific States of North America — says the London *Academy*, is announced from Australia. Mr. G. B. Barton, of Sydney, has undertaken to write a history of New South Wales from official records, in fifteen volumes, each volume covering the term of a governor's administration. The first volume will include the letters written by Governor Phillip previous to his departure from England and while on his voyage, and also his despatches from Sydney which have not before been published. In the appendix will be given, besides the Act of Parliament founding the colony, the Governor's commission and instructions, and the letters-patent constituting the courts of civil and criminal jurisdiction, and many other unpublished records of literary and historical interest. There will also be a bibliography of the colony down to 1808. —— Mr. Richard Herne Shepherd has in hand a revised edition of his 'Tennysoniana,' first published about ten years ago. The new edition has been corrected and enlarged to date, and will contain a copious and exhaustive bibliography. —— Mr. Frederic G. Kitton has now ready for immediate publication the first part of the work entitled 'Charles Dickens with Pen and Pencil,' upon which he has been engaged for more than two years. The principal features of this work are, according to the *Academy*: (1) a description of all the portraits of Dickens, with unpublished memoranda concerning them; (2) records of his personal characteristics, with a collection of reminiscences contributed by surviving friends; (3) one hundred illustrations, including nearly fifty portraits, reproduced by line-engraving, mezzotint, etching, photogravure, etc. Queen Victoria has allowed Mr. Kitton to engrave for his collection a pencil sketch of the novelist now in her possession. The drawing, which was taken from the life by R. J. Lane, represents Charles Dickens during the Pickwickian days. Her Majesty bought it from Mrs. George Cattermole, widow of the artist who assisted in illustrating 'Master Humphrey's Clock.' It will thus be published for the first time, and will be of interest to all Dickens collectors. The mode of publication will be twelve parts, printed on fine paper, imperial quarto, each of which will contain three full-page plates. The edition is a limited one; and subscribers should address Mr. F. T. Sabin, Garrick Street, W. C., London.

— The much-delayed number of the *American Journal of Psychology* has at length appeared, dated August, 1888. Its contents differ from what the preceding numbers lead to anticipate; and it cannot be said that the change is for the better. While the main articles have been in the line of the new departures in psychology, the single contribution to this number is a minute historical study of Heraclitus. The study itself, apart from its appearance in this journal, shows unusual care and sound scholarship, and reflects great credit upon Dr. G. W. Patrick, its author. The reviews and notes continue to be abundant and interesting. They are classified under the heads of, 'The Nervous System,' 'Experimental,' 'Hypnotism,' 'Abnormal,' Anthropological,' 'Miscellaneous.' The price of the journal is advanced from three to five dollars per annum.

— The November number (No. 38) of the Riverside Literature Series (published monthly, at 15 cents a number, by Houghton, Mifflin & Co., Boston) contains four of Longfellow's most popular poems: 'The Building of the Ship,' 'The Masque of Pandora,' 'The

Hanging of the Crane,' and 'Morituri Salutamus.' Portions of the 'Building of the Ship' have been quite extensively used in schools, but the whole poem has never appeared before in so cheap a form. To those who have read (and who have not?) the 'Paradise for Children' in Hawthorne's 'Wonder Book' (see number 17 of the same series), which tells the story of Pandora's Box, the 'Masque of Pandora' will be especially interesting. The 'Morituri Salutamus' was written for the celebration of the fiftieth anniversary of Longfellow's graduation from Bowdoin College, and is considered one of his best poems. 'The Hanging of the Crane' is too well known to need more than a passing mention. These poems, while simple enough for children of the Fourth Reader grade, will be enjoyed by all lovers of Longfellow, and by all admirers of good poetry. These poems are accompanied by very carefully prepared notes, which, without being voluminous, will be found helpful at just the places where help is needed.

— In *Science*, No. 299, page 198, first column, 14th line from the top of the page, for 'house-leek,' read 'hawk-weed.'

LETTERS TO THE EDITOR.

On Alleged Mongoloid Traits in the American Race: In Reply to Dr. Ten Kate.

IN the last number of *Science*, Dr. Ten Kate makes a series of strictures on the paper I read before the American Association for the Advancement of Science, entitled 'On the Alleged Mongoloid Affinities of the American Race.' These strictures close with some sentences which I should think a scientific mind would hesitate to write, as certainly a scientific mind will refuse to accept, — sentences to the effect that any one who differs from the opinions expressed by the writer of those strictures cannot believe in either anthropology or natural history. In spite of this *egomet dixi*, I venture to retain my opinion, and even to defend it.

But first let me state clearly what were the aim and limit of my paper.

These were simply that *in our present state of knowledge* there is no sufficient ground, either in language, in culture, or in ethnic anatomy, for the oft-repeated assertion that the American Indians belong to the Mongolian sub-species of the species *Homo*. What future researches may prove, such as those of Dr. Ten Kate, I do not pretend to say; and I distinctly avoided his example of basing present theories on imagined prospective discoveries (see his remarks in his footnote).

Some of his arguments are so extraordinary that they merit special attention. Notably so is that with reference to language. He makes the astounding assertion that we should group together languages because the nations speaking them present similar physical characteristics! I need but ask if there ever lived a scientific linguist to whom this novel system occurred. Dr. Ten Kate acknowledges, that, as yet, no linguistic connection has been shown between American languages and those of the Asiatic Mongols. This is all I asserted.

Nor does my critic attempt to show a single element of Mongolian culture in America. I maintain that this culture is autochthonous; it can all be accounted for by the sociologic history of the nations possessing it; and when such is the case, it is totally unscientific to go elsewhere to seek its origin.

Dr. Ten Kate is most diffuse on somatologic points; and on these he is singularly inconsistent. He argues that the color and character of hair and skin are of little or no importance as race distinction, adducing the Teutons and Italians as examples. I differ with him here, and I deny the correctness of his observations about the color of the American Indians; but grant his position, and does it not also prove the futility of those arguments based upon the alleged identities in these respects of Americans and Mongolians? In either case my thesis would stand intact.

With regard to the relative prevalence of the *ossa Incæ*, I must retain my opinion until Dr. Ten Kate is more explicit in his figures, and the same with reference to the glabella. I am prepared to furnish statistics when called upon.

In his paragraph about brachycephaly the critic contradicts not one of my statements, although he asserts that he does. If I have anywhere said that there are no brachycephalic tribes in America, I should like the passage pointed out. His references to half a dozen authors in this connection are meaningless. Why he finds himself under the necessity of pointing out the distinction between the nasal index as determined on the bony skull and the living face, I know not. American anthropologists do not require instruction in this elementary fact. If he had been familiar with Topinard's 'Elements d'Anthropologie,' to which he refers, and which I quoted in that connection, he would have known that any intimation that I had neglected that distinction was groundless.

I shall not pursue this reply further. The reader may decide whether Dr. Ten Kate has shown a single well-established affinity between the Americans and the Asiatic Mongols. I assert he has not; and I add that such affinities are not more numerous than between the Americans and, say, the Berber tribes of North Africa.

D. G. BRINTON, M.D.

Media, Penn., Nov.

The Theory of the Origin of Species by Natural Selection.

A REMARKABLY clear conception of the elements of the theory for which Charles Darwin has become famous was published almost thirty years prior to the appearance of 'The Origin of Species.'

I have just brought home with me from London a number of geological works published in the early part of this century, among them a copy of Robert Bakewell's 'Introduction to Geology.' The passage I am about to quote from it appeared first in the fourth edition, which was published in 1833; and it is repeated in the fifth edition, published in 1838, with an interesting footnote (see pp. 403, 404).

The author is discussing Deshayes's classification of the various tertiary formations by means of comparison of the faunas with the living species. In the course of the discussion, he refers to the experiments of Robert Bakewell of Dishley, in Leicestershire, in producing choice breeds of sheep by artificial selection. He describes Mr. Bakewell's method as follows: —

"He first travelled over England, and part of the continent, to discover and select animals of the same species, possessing certain peculiarities of form, and other qualities which he was desirous to render permanent. By selecting two animals to breed from, which possessed the desired qualities in an eminent degree, and afterwards selecting from their offspring those in which these qualities were most conspicuous and breeding again from them, the peculiarities were further increased. By continuing the same selection through four or five generations, he obtained races that would transmit the same qualities permanently to succeeding generations."

Then the author applies this principle to explain the appearance of new forms of *Mollusca* in the tertiary beds, as follows: —

"Let us, however, imagine, what is very possible, that a number of individuals of one species of bivalve or univalve shell were driven, during a violent storm, into a distant part of the ocean, where the animals could no longer obtain their accustomed food, but were still able to support life by aliment of a somewhat different kind. Let us suppose that the annoyances to which they had before been subject, from natural enemies or other causes, were changed for annoyances of another kind. Under these different circumstances, is it not probable that the animals themselves would undergo some change, and modify the construction of their shells in some degree, to render them better suited to the new conditions in which they were placed? Thus, in the course of a few generations, we should have a race which conchologists would call a distinct species."

To this the author adds this footnote in the fifth edition (1838): "What was above stated hypothetically in the fourth edition of this work may now be asserted as ascertained facts. Dr. Harlan, a distinguished American naturalist, informed the author that testaceous *Mollusca* removed from one river to another in America were observed in time to change the form of their shells. Mr. Gray, in the Philadelphia Transactions, 1833, states that great varieties of form are produced in shells of the same species, by a removal from calm to agitated water."

Here the chief points of Darwin's theory of the origin of species are expressed. They are founded, also, upon observed facts. The

results produced by artificial selection are taken as examples of what would take place in nature under the assumed circumstances; and this "natural selection" is proposed as a sufficient explanation of the appearance of "a race which conchologists would call a distinct species."

The author states also, referring to Mr. Bakewell, "I have heard him say, that he scarcely knew any assignable limits beyond which these changes, both external and internal, might not be carried" (p. 402). Another statement is interesting as showing that Charles Darwin doubtless knew of this Mr. Bakewell, and may have heard him discuss these matters in his boyhood. In a footnote (p. 403) we read, "Mr. Bakewell of Dishley was in a considerable degree self-educated; but he possessed a strong original mind, which was enlightened by study and meditation. He was also a man of great moral worth, and was intimately acquainted with Dr. Priestley, Dr. Darwin, and other eminent philosophers who inhabited the central part of England, towards the close of the last century. The late Countess of Oxford once asked the author of the present work, *whether he was related to the Mr. Bakewell who invented sheep.* He replied that he was of the same Leicestershire, or originally Derbyshire family,"

It appears from these quotations that "the Mr. Bakewell who invented sheep," and the Mr. Bakewell, author of 'Introduction to Geology,' were true Darwinists before Charles Darwin. And who can tell how much of Mr. Bakewell's theory of natural selection was transmitted to the youthful Darwin through the delicious mutton of the Leicestershire Downs? H. S. WILLIAMS.

Cornell University, Nov. 3.

'Bi-daily.'

THE *Monthly Weather Review* of the Signal Service for August contains the term 'bi-daily,' as applied to the present system of indications, which are now made twice each day. That this is an incorrect use of the prefix 'bi' may be discovered by consulting a dictionary, or by reflecting upon its derivation.

The prefix 'bi' doubles the word to which it is prefixed. A biennial election is a two-yearly election, i.e., once in two years; and a bi-daily observation is an observation made every two days.

An event occurring twice each day is half-daily or semi-daily, the same as a semi-annual dividend or a half-yearly payment.

The word 'tri-daily,' which is applied to the signal-service observations, has attained by usage the meaning 'three times a day,' because of the lack of any other simple prefix. But the extension of this improper usage to the prefix 'bi' can have no warrant, since we have the correct prefix 'half' or 'semi,' both of which are already in common use. GEO. E. CURTIS.

Topeka, Kan., Nov. 1.

Buffalo on the Texas Plains.

THE re-opened discussion of the buffalo question calls for a few statements concerning these animals in Texas. Two hundred head or more of these animals may be found in the Panhandle of Texas, on the Llano Estacado, and in No-Man's Land. Some are on the Palo Duro Cañon ranch, owned by Capt. Charles Goodnight; others in the Texas Capital Syndicate, or XIT pasture, especially on the North Plains, i.e., north of the Canadian River; still others are at large. Probably twenty or more buffalo calves were captured this spring in that region and driven to Kansas for mercenary and breeding purposes. The cow-boy's ideal, like that of the more 'refined' sportsmen, is to shoot these cattle at sight, but the proprietors of the ranches are doing much for their protection.

There are also many buffalo on the South Plain. The antelope, black-tailed deer, and many rare but smaller mammals, are found in the same region — all of which I saw or heard of during a recent visit to Plaza Larga, Tucumcarri Mesa, and the Texas Panhandle. Naturalists desiring these forms should go to Tascosa, Tex., near the New Mexican line, a place easily accessible from Kansas, Denver, and Texas, *via* the Fort Worth and Denver Railway. The capture of wild horses is a profitable pursuit in this region.

ROBT. T. HILL.

University of Texas, Austin, Nov. 7.

Answers.

37. WHAT NUMBERS DOES IT TAKE TO MAKE A BILLION? —Responding to Query 37 (*Science* xii. 204), 'What numbers make a billion?' I would offer the following remarks: The term 'billion' appears to have been introduced by the Italian arithmeticians early in the fourteenth century. Peacock, in his admirable history of arithmetic (*Encyclopæd. Metropol.*, vol i.), states that the Italians made "a great addition to their former numerical language by the use of the word 'millione' (which properly signifies 'great thousand') to denote the square of one thousand; and which was followed by the words 'billione,' 'trillione,' etc., deduced immediately from the form by pursuing the natural analogies of the language: a series of numerical terms was thus formed, proceeding not by tens, but by millions." The new terms were slowly adopted by the nations of Europe, but in every case in their original and etymological sense.

In Spain these terms were used probably not long after their establishment in Italy; in France they were adopted not much before the opening of the sixteenth century; in Germany, early in the sixteenth century; in England, not till the close of the seventeenth century; and in Russia, early in the eighteenth century. Locke, who published his great essay in 1690, complains that his countrymen were accustomed to speak of millions of millions of millions instead of using the more convenient term 'trillions;' and he gives an example of the proper notation to sixty places of figures, divided into sextuple periods, and duly named up to nonillions. "The ordinary way of naming this number in English will be the often repeating of millions of millions of millions of millions," etc. (*Human Understanding*, book ii. chap. 16, sect. 6). It is important to observe, that, wherever introduced, the term 'billion' uniformly designated the *bis* power of the million, — a value, the prefix to twelve places of figures. In the Italian dictionary of the Accademici della Crusca, the word 'bilione' (or 'billione') is defined, "un milione di milioni." In the Spanish dictionary of the Academia Española, the word 'billon' is defined, "un millon de millones," or a million multiplied by itself. In the German dictionary of Dr. Daniel Sanders, 'billion' is defined, "millional million." And in Littré's 'French Dictionary,' after defining the word, it is stated, "The forms billion, trillion, etc., were devised in the sixteenth century to signify periods of six to six figures: counting from the right, units were represented by the first six places of figures, the millions were represented by the figures from 7th to the 12th places, the billions were represented by the figures from the 13th to the 18th places, and so on." Est. De La Roche's 'Arithmetique' is quoted as stating, "A billion is equal to a million million." Littré adds (without explanation), "It was not till the middle of the seventeenth century that the rule of separating into periods of six, was changed to separating into periods of three figures, and the original *billion* was divided by 1,000." It is not a little surprising that our compilers of school arithmetics (whether smitten with Francomania or with Anglo-phobia) have almost unanimously adopted the modern French perversion of the terms 'billion,' 'trillion,' etc. And thus business-men are in the habit of numerating '-illions' by places of three (*after the million place*), while astronomers and mathematicians preserve the original and logical numeration by places of six figures. It needs but a bare inspection of the terms themselves to see that this French neologism (of the last two centuries) is not only anomalous, but wholly irrational. The form of the words 'million,' 'billion,' 'trillion,' 'quadrillion,' 'quintillion,' etc., necessarily denotes some co-ordination of numerical progression. What can it possibly be on the pedagogue's system? The expression 1 000, 000 000 (one thousand million) does not admit any logarithmic bisection. How can it, then, be in any sense a *billion?* If it be any kind of a *bis*, what is its primary? It is an impossible second power, having a surd for its root. Had the French arithmeticians cut down at the same blow the *million* to the *mille*, the scheme would at least have been consistent. A true billion is evidently a *second* order of million, and the only rational order is the second power.

To any reflecting mind the school-book numeration is simply absurd, and its prevalence is a very puzzling phenomenon.

W. B. T.

Washington, D.C., Oct. 30.

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FRIDAY, NOVEMBER 23, 1888.

THE MOST CASUAL READER of magazines and reviews cannot have failed to notice the increasing share of attention being given by them to educational matters. The *Century* has honored the memory of Dr. Edward Thwing, and described Uppingham School; it has also given space to a discussion of manual training and to other school subjects. The *Atlantic Monthly* printed in a prominent position President Eliot's suggestions as to how the school courses might be enriched and shortened. And now comes the *Nineteenth Century*, which, in its November issue, gives the post of honor to a document which, it is safe to say, will rank as one of the most important and significant of modern times. It is a protest against the sacrifice of education to examination, and is signed by several hundred of the most prominent and influential men and women in Great Britain. We notice in the long list the names of Professor Bryce, Henry Bradlaugh, Lord Lytton, Grant Allen, Prof. J. S. Blackie, Oscar Browning, Canon Creighton, Edward A. Freeman, Edmund Gosse, Frederic Harrison, Dr. James Martineau, Frederick Pollock, G. J. Romanes, Professor Westcott, Lionel Beale, Dr. Crichton-Browne, Sir Morell Mackenzie, Sir Edwin Arnold, Mrs. E. Lynn Linton, and Miss Charlotte M. Yonge.

The document records the "strong protest of the signers against the dangerous mental pressure, and misdirection of energies and aims, which are to be found alike in nearly all parts of our educational system. Alike in public elementary schools, in schools of all grades and for all classes, and at the universities, the same dangers are too often showing themselves under different forms. Children are treated by a public department, by managers and schoolmasters, as suitable instruments for earning government money; young boys of the middle and richer classes are often trained for scholarships with as little regard for the future as two-year old horses are trained for races; and young men of real capability at the universities are led to believe that the main purpose of education is to enable them to win some great money prize, or take some distinguished place in an examination. We protest most emphatically against such a misdirection of education, and against the evils which necessarily arise from it." The resulting evils are then specified in detail and at some length. They are classified as physical, intellectual, and moral. The *Nineteenth Century* prints, together with the protest, comments on it by Prof. Max Müller, by Professor Freeman, and by Frederic Harrison. Professor Müller recalls the fact that he was, forty years ago, an ardent supporter of a system of examinations for the civil service. He now sees that this has been carried too far, and the fault has been, not with the application of the principle of examination, but with the principle itself. Mr. Harrison's paper is the most pungent and practical of all. He points out that "examination, having been called in to aid education, has grown and hardened into the master of education. Education is becoming the slave of its own creature and servant. I do not deny that examination has its uses; I do not say that we can do without it. I say that it is a good servant, but a bad master; and, like good servants turned bad masters, it is now bullying, spoiling, and humiliating education."

It will be interesting to notice how much attention this important paper attracts in this country, and how much influence it will have with these slaves of routine and examinations, our old-fashioned schoolmasters. There are men who regard the examination as sacred, and not to be touched or altered, and there are systems, that of New York City, for example, that are built upon a vicious examination system as a foundation. Some time since, we called the attention of the readers of *Science* to this examination question, and printed some valuable articles on the subject. We can only hope that our American teachers will listen to the voice of England's experience, and take some steps that will make such a protest both unnecessary and impossible in the United States.

THE QUESTION WHETHER the growth of forests causes an increase of rainfall is both a scientific and an economic one; and as not only in this country, but also in Europe, great corporate or private interests are to be affected by its decision, much of the discussion of it, unfortunately, has not been of a purely scientific character. It has not been carried on for the purpose of arriving at the truth, but to sustain some proposition asserted in advance to be true. It has been what Professor Henry would have called 'debate' as distinguished from 'discussion.' In Europe there is a great outcry among the common people against the maintenance of forests over such great areas for the preservation of game and to promote the personal pleasures of a few nobles, while the peasants are starving for the want of land to cultivate. But the nobles reply, that, if the forests are cut down, the rainfall will be diminished, the lands that are now fertile will become barren, so that the common people will be worse off than ever; and they send forth their well-paid scientific men to establish stations, make investigations, and prove the truth of this proposition. We do not mean to say that scientific men in Europe consciously prostitute themselves in this way,— they earnestly seek the truth, and do so with much learning and diligence, — but, so often has it been asserted that the growth of forests promote rainfall, that it has almost become an axiom in science as well as among the people; and the results of any investigations that seem to sustain it are of necessity more readily entertained than those which point to the converse. An interesting account of the latest and the most thorough examination of a small area for the purpose of solving this question is given in the abstract of Professor Fernow's paper, read before the Philosophical Society of Washington at a recent meeting. In this country many of the great railroad corporations have vast areas of land to sell in the Far West. They desire to induce Eastern people to go there, settle on these lands, and build up cities and towns, so that the business of their lines may be increased. But an idea prevails in the East that the best lands have already been occupied; that the rainfall beyond the present line of civilization is either so small, or so unevenly distributed throughout the year, as to make the successful production of a crop a matter of great uncertainty; and they hesitate. But the agents of the railroad companies reply that the climate of the Far West has changed; that the planting of trees upon what was once arid lands has increased the amount of rainfall, and caused a more equal distribution of the water in the streams; so that now lands that were once unfit for cultivation have become fertile, and certain to produce crops every year; and they quote figures to prove it. Fortunately there are men engaged in the investigation of this subject who have no interests to serve but the discovery of the truth; and *Science*, in its present issue, presents contributions to this branch of the discussion by two men of this class. The truth can be reached only after a thorough discussion.

THE INFLUENCE OF FORESTS ON THE QUANTITY AND FREQUENCY OF RAINFALL.

THE effect of the growth of forests on rainfall is receiving fresh attention in the Philosophical Society of Washington. At a recent meeting of that society Professor Fernow of the Department of Agriculture gave an historical review of the experiments made in Europe during the present century to determine the influence of forests on the quantity and frequency of rainfall. When the reading of Professor Fernow's paper was concluded, there was no time for the discussion of it, and a symposium on the subject was arranged for the next meeting. Mr. Henry Gannett opened the discussion, and his address was the most notable of the evening. He was followed by others, notably by Gen. A. W. Greely, who has made this subject a special study. That part of Professor Fernow's paper relating to the experiments in Europe are given here, followed by Mr. Gannett's remarks in full.

Professor Fernow's Paper.

I wish to call attention to the latest, most important, in fact the only scientific work, it seems to me, which has been done to establish the important but difficult question of the influence of forests on precipitation. I refer to the work of Dr. F. J. Studnika, professor of mathematics at the University of Prague, published under the title 'Basis for a Hyetography of Bohemia,' in which the results of many years of observation at 700 ombrometric stations are embodied, critically sifted, and scientifically considered.

The work of ombrometric observations, although begun in Bohemia during the last century, was newly organized in 1879 or 1880, when a systematic net of ombrometric stations was instituted; and in 1885 and 1886 it was extended over 700 stations, for the purpose of obtaining accurate data of the quantity and distribution of precipitation over the kingdom. Uniform ombrometers were used and very carefully placed. As at present organized, there is one station for every seventy-five square kilometres (about thirty square miles). No other country, I believe, can boast of such a service. Although the time of observation at most stations has been short, and the average would have been more accurately represented by an extension of observations for ten or twelve years, yet the last four years of observation, for which all stations furnish data, according to the author, represent two extreme and two average years, and are therefore quite useful.

The very large mass of material permitted a sifting-out of doubtful observations without impairing the number available for the construction of a rain-map of Bohemia, showing by isohyetal lines seven rain-belts or zones. The zones are so arranged that the lowest shows less than 500 millimetres rainfall, the three following differ by 100 millimetres each, the fifth and sixth by 200 millimetres, and the seventh by 300 millimetres; showing, therefore, a rainfall of 1,200 to 1,500 millimetres.

The central basin divides itself into halves by a line from north to south, running somewhat east of the middle Moldau, crossing the Elbe near the mouth of the Iser, and following the latter river; the western half showing the smaller amount of precipitation, namely, 500 to 600 millimetres; the eastern, with 600 to 700 millimetres, continuing in a small belt along the foot of the Erzebirge and the Boehmer-wald, encircling the first zone.

The other isohyetal lines do not embrace continuous areas, but follow in small belts the trend of the mountains. The larger amounts of precipitation are found in belts or islands in the higher altitudes of the mountains which surround this great basin. The continuity of the zones is much interrupted, so that it would be difficult to describe it without a map.

The maximum rainfall with over 1,200 millimetres is observed in the south near the sources of the Moldau and Wotawa; in the north, near the sources of the Elbe, Iser, and Aupa, on the range of the Schneekoppe. In regard to the distribution through the months, the experience has confirmed, that, with increasing absolute height, the winter precipitation increases in greater proportion than that of the summer, while those of spring and autumn are nearly equal.

Sufficient material was on hand from which to calculate the influence of altitude on the increase of precipitation, although for altitudes above 500 metres the material is not considered sufficiently accurate. Yet the general law is well shown, that with the altitude the quantity of precipitation increases in a retarded progression. This progression is calculated by forming altitude zones from 100 to 100 metres, grouping the stations in each, calculating the mean elevation and also the mean annual precipitation as observed for each class; then, by dividing the difference of precipitation in two neighboring zones by the difference of altitude, the amount of precipitation which corresponds to each one metre of elevation within that class is found. With this figure, the average amount of rainfall which theoretically belongs to each station according to its absolute elevation can be approximated by adding to or subtracting from the mean precipitation of the class as many times this amount as the actual altitude differs from the mean.

A single example will make this clear. Tetschen, for instance, is situated 150 metres above the sea-level. According to the table, the average elevation of 13 stations of the lowest zone, to which Tetschen belongs, is 182 metres, with an average precipitation of 506 millimetres. Now, as Tetschen has an elevation of 32 metres lower than the average, the rainfall should be $32 \times .79 = 25.4$ millimetres less than the mean of the class; hence, theoretically, according to its altitude, the quantity of rainfall for Tetschen should be $506 - 25.4 = 480.6$ millimetres; that is, 248 millimetres less than that actually found in an eight-years' average.

By using the figures for the two extreme zones and dividing by 100, the mean increase of precipitation for every 100 metres elevation is found to be 69 millimetres.

And now comes the application of this method to our proposition. The author argues that if the actually observed rainfall differs considerably from the theoretical, this is an indication that special agencies are at work.

He finds now, that, of 186 stations which he subjects to scrutiny (those offering the longest and most trustworthy observations), 48 show a considerable difference between the observed and the theoretically expected rainfall, and he finds also that these stations are situated in the most densely wooded portions of the kingdom.

The increased rainfall at the 48 stations is so considerable, that sufficient quantity may be ascribed to other local causes, as, for instance, height and form of a mountain-range in front or back, etc., without losing significance. Besides, the greater amounts of rainfall at these stations have been used in calculating the averages for the altitude zones, magnifying, therefore, these averages so that the actual difference between the calculated quantity and the actually observed one appears really smaller than if the quantities from deforested and forest areas are compared.

Expressed in percentages of the height of precipitation, an increased rainfall is shown for several localities in very large quantities, which will allow considerable reductions for other influences without losing their significance for the main proposition.

Especially important appears the fact relating to two stations near the rain minimum, which also shows this influence of the forest.

Lastly, as a matter of interest, I may state that the water balance is drawn for the whole kingdom, which is of special value, because the political boundaries coincide with those of the upper Elbe watershed; therefore it is easy to determine how much of the yearly rainfall is removed by the natural water-courses. According to the calculations made for the various zones by addition, the total precipitation upon the area of 51,955.98 square kilometres (about 20,000 square miles) of the kingdom is found to be 35,398,670,000 cubic metres, of which the Elbe carries about one-quarter, or ten cubic kilometres, to the sea. This figure represents a mean rainfall for the whole country of 681 millimetres, while the mean observation is 693 millimetres.

In conclusion, allow me to say that I believe neither of the methods employed will alone be sufficient to investigate such a complicated relation in its generality as that which they try to establish or refute. All of them, modified and provided with such safeguards as will exclude the many disturbing influences, will have to work together towards a solution of the question.

Mr. Gannett's Paper.

At its last meeting, the society was favored with a very interesting and important paper by Dr. Fernow, in which there was presented a *résumé* of certain investigations made in this country and

Europe, concerning the supposed influence of woodland upon precipitation.

While criticising the methods used in these investigations, Dr. Fernow did not, if I understood him right, give his own views upon the main question.

The question is, Does the presence of woodland influence rainfall, does its increase increase rainfall, and does its destruction reduce it? I know no theoretical grounds upon which an affirmative belief can be based.

While the question is an interesting one to science, it is also a particularly important economic one to this country. The future value of a large part of our arid region, and our policy in regard to it, depend upon the decision. If the presence of woodland increases rainfall to an economic extent, we should begin at once to plant trees all over our Western plains, and supply them with water until they in turn supply themselves and the adjacent land with moisture. If they do not increase the rainfall, then perhaps the land which is now being covered with woods can be more profitably used for wheat. Again: the welfare of much of the eastern United States, now well watered, may turn in the future upon the decision of this question. In some parts the forests are being cut away, and thereby the rainfall may be reduced to such an extent as to make the soil unproductive, in which case the timber-cutting should be stopped in time.

From this the economic point of view, it must be recognized that to be of any value, the influence of woodland upon rainfall must be considerable in amount. A minute influence is equivalent to none at all, so far as economic effect is concerned. If it should be found that woodlands induce only a trifling modification in rainfall, the solution of the question is substantially in the negative, viewed economically. In our examinations of records and other tests of the comparative amount of rainfall under differing conditions of forest-covering, we are, then, to look for changes of considerable magnitude. The variations in rainfall from year to year and from place to place are great, — so great as to mask, in a limited series, or in observations at a few stations only, any general change. It is, of course, understood that the difficulty in the way of detecting the general movements of rainfall lies in these temporary and local fluctuations, and it is apparent that to eliminate them it is necessary to use what Dr. Fernow aptly calls the wholesale method, to bring together into the investigation large numbers of observations, from many stations, scattered widely over the territory under examination. I cannot conceive any retail method that will yield a result worthy of any confidence, as is shown by the fact that it is very easy so to select stations and years of observation as to obtain any desired result.

Of the retail methods of investigation in use in Europe, cited by Mr. Fernow, that of pairs of stations, one situated within the forest, the other 100 metres outside it, seems to promise no result; first, because it is a retail method, and, second, because if the forest has any influence, it must, in order to be of any value, be felt more than 325 feet away from the margin of the forest. We cannot afford to cover the land with woods in order to increase the rainfall. We must have some land to cultivate. The conclusions from the observations in Bohemia, cited by Mr. Fernow, can only be misleading. To compute from the rainfall in the open valley, and from an estimate of the rate at which rainfall increases with elevation, the theoretical rainfall upon cleared mountain-sides, and then to conclude from the discrepancies between these results and the observed rainfall upon the timbered mountains that the forests have had a certain effect upon the rainfall, is a case of theory run riot.

I know of but two attempts to use the wholesale method, both of which were mentioned by Mr. Fernow, — that of Mr. Harrington and my own. Mr. Harrington's method consists in a comparison of two rainfall maps made from data of different dates, — the Blodget map, made in 1857; and the Denison map, made in 1844. The two maps are not strictly comparable, as the first purports to show areas of equal rainfall, while the last shows lines of equal rainfall. Nevertheless, the former may be made rudely comparable with the latter by means of certain assumptions regarding the relative positions of these lines and areas. Mr. Harrington's examination was confined to the supposed increase of rainfall on the plains. Finding that the isohyetal lines of 20, 25, and 30 inches were in some places slightly farther west on the Denison than on the Blodget map, he concluded that the rainfall has increased.

What is the value of this evidence, and, first, of what authority are the maps? Upon the Blodget map I find only five stations in the entire area of the plains, north of Texas; viz., Forts Riley, Leavenworth, Atkinson, Arbuckle, and Kearney. The only data in this area of nearly half a million square miles consists of the observations at these five stations. It may be safely said that the rainfall-curves in this area are at least 99 per cent hypothetical. They might as well be drawn a hundred miles on either side of the position assigned them by Mr. Blodget, without contradicting the observations. Their position is necessarily based almost entirely upon Mr. Blodget's judgment, and not in any appreciable degree upon observational data. The Denison map is better. The worst that can be said of it is that it is a popular map, made to sell. But the weakest link in a chain limits the strength of the chain, and the Blodget map is the weakest link in Mr. Harrington's chain of evidence. With it his conclusions must stand or fall, and, as has been shown, this link is most absurdly weak.

Let us look at the matter from another point of view. If Mr. Harrington's conclusions regarding the rainfall on the plains, drawn from a comparison of these two maps, are correct, similar conclusions regarding the rainfall of other parts of the country must likewise be correct, especially as the data upon which the map is based are elsewhere more abundant, and the maps correspondingly more reliable. Let us see what other changes are shown by the maps to have occurred. About Cape Hatteras the rainfall has apparently increased from 48 to over 70 inches; in southern Louisiana, from 45 to 60; in northern Florida, from 50 to 65; in the mountains of North Carolina, from 36 to 48; and so on. It is unnecessary to specify further changes, as there is scarcely any part of the country in which, if this method of reasoning be correct, great changes in rainfall have not occurred between 1857 and 1884.

The method employed in my investigation of this question, and the results obtained, are set forth in an article in *Science* for Jan. 6, 1888. The explanation there given seemed to me to be sufficiently clear for the average reader. It appears, however, that it admits of being misunderstood, and has been misunderstood by Mr. Fernow. I will therefore state it once more, and with greater fulness. The method used is a wholesale one. Certain areas in this country, of great extent, in which the changes in respect to forest-covering have, within recent years, been radical, were selected, and an examination was made of the rainfall measurements in these areas during the time of foresting or deforesting, in the hope, not of obtaining a quantitative expression for the influence of forests, but of learning whether they have appreciable influence. One of the areas selected was the prairie region, where it is well known that during the past fifty years the wooded areas have greatly increased, — so greatly as to change the whole aspect of the country. This increase of woodland has been a progressive one, going on gradually year after year. Now, if increase of woodland increases the rainfall, it follows necessarily, that, barring its sporadic fluctuations, the rainfall also has increased progressively in this region. The following, then, is the proposition to be proved or disproved by the rainfall records: that the rainfall has increased, and that progressively, in the prairie region during the past fifty years, as foresting has gone on. Within this region I had access to the records of twenty-four stations scattered widely over the area, each station having a series of records of considerable length, ranging from ten to forty years. These series are scattered over the past fifty years in an irregular manner, and no attention was paid to the particular years which each series embraces, as it is not believed that it is a matter of any importance. The series from each station was cut in halves, and each half added, giving the total rainfall of each half. Now, were there no sporadic fluctuations, — in other words, were the rainfall regular in amount, — the comparison between the sums of the halves of each series would be sufficient to base a conclusion upon. If the rainfall had increased, the earlier half series would be less than the later half. As a matter of fact, however, these individual results are very discordant, owing to the irregularities of rainfall; and it is necessary,

in order to get rid of these irregularities, to get together a larger number of observations. This is done by simply adding together all the first halves and all the second halves: that is, in this case, I have added columns, etc. As I understand it, exception is taken to this operation, as bringing together quantities which are not homogeneous. Suppose that, instead of adding up directly each half of a series, the mean rainfall at a station is obtained from the whole series. Now, if the proposition as above stated be correct, this mean rainfall is, barring irregular fluctuations, the rainfall of the middle year of the series. Let the residuals be taken. Is there any impropriety in adding up the residuals, not only in each half-series in one sum, but those of all the half-series, for comparison of the sums of the two half-series?

Or, to put it in mathematical form, let R equal the mean rainfall of a series, which is equal to the rainfall of the middle year, r the rainfall at any time, t the interval in years before or after the middle year (plus when after, and minus when before), x equal the rate at which the rainfall is supposed to increase, which may be assumed as constant over the area, as it is a qualitative rather than a quantitative result which is sought. We desire to learn whether x has any considerable value. Then

$$r = R \pm tx, \text{ and } x = \frac{r - R}{\pm t};$$

and, for a single series,

$$x = \frac{r_1}{t_1} + \frac{r_2}{t_2} + \frac{r_n}{t_n} - \frac{r^1}{t^1} - \frac{r^2}{t^2} - \frac{r^n}{t^n},$$

the mean rainfall R being eliminated: x being the same over the entire area, and the mean rainfall being eliminated, the above equation applies to all series, and they may be properly combined for the purpose of obtaining the value of x, and

$$x = \left[\frac{r_n}{t_n}\right] - \left[\frac{r^n}{t^n}\right].$$

As has been stated, this method was used to test the above proposition, in the prairie region. Twenty-four stations were used, and the observations of 428 years were used in evidence. The result showed that there was a trifling amount *more* rain in the earlier than in the latter half of the series. In short, it showed that the rainfall had not increased.

It was applied in Ohio, which from a forested area has become with settlement mainly a deforested area. Under the terms of the proposition, the rainfall should have diminished, but the amount of the diminution is trifling, being but .21 of an inch per year. To this result twelve stations, with 294 years of observation, contributed.

Southern New England, comprising some 20,000 square miles, was originally a densely forested region. With the progress of settlement it was almost entirely cleared. In recent years, say since 1860, a reverse movement has been going on. The competition of Western farms and cheap transportation is driving New England farmers to other vocations, or is forcing them to move to other parts of the country. Thus the farms are being abandoned, and are growing up to woods. To-day Massachusetts contains 52 per cent of woodland, and Rhode Island even more. Southern New England, then, presents two phases of change for investigation. During the earlier period, with the cutting-away of forests, the rainfall should have diminished, while during the past twenty-eight years it should have increased. During the first period there were used in the investigation eighteen stations, with 400 years of observation. The examination showed that the rainfall had *increased* while deforesting was going on.

In the second period fourteen stations were used and 200 years of observations. The examination showed no change whatever.

This investigation has convinced me that forests exercise no influence whatever upon rainfall. I wish to state this plainly, as it was suggested at the last meeting that I had some doubts concerning the results obtained. I regret that any thing in my paper should be capable of such a construction, as it was certainly as far as possible from my thoughts.

I am aware that this conclusion is at variance with the popular idea, and that a popular idea is not a thing to be disregarded, as there is usually some reason for its existence. We find woodland and a heavy rainfall generally co-existing. In almost all places enjoying a heavy rainfall, the land is covered with forests, unless they have been removed by man. It may be that in this case an effect has been mistaken for a cause, or rather, since it is universally recognized that rainfall produces forests, the converse has been incorrectly assumed to be also true.

Although forests have no influence upon precipitation, yet they do exert a certain economic influence. Without increasing rainfall, they, in common with other forms of vegetation, economize that which falls, retaining it somewhat as a reservoir, and preventing its rapid descent into the streams. In this way, too, forests tend to reduce the magnitude of floods and to regulate the flow of rivers, thus preventing disaster and improving navigation. This retention of the rainfall is, however, accompanied by a rapid evaporation from the leaf surfaces of the forest, whereby a considerable proportion of the rainfall returns to the atmosphere without reaching the earth. On this account it is urged, and I think with reason, that in our arid region, which is dependent for irrigation upon its streams, it is advisable to cut away as rapidly as possible all the forests, especially upon the mountains, where most of the rain falls, in order that as much of the precipitation as possible may be collected in the streams. This will cause, not a decrease in the annual flow of the streams, as commonly supposed, but an increase, coupled with a greater concentration of the flow in the spring months, and result in rendering fertile a greater area of the arid region. It may be added that the forests in the arid region are thus disappearing with commendable rapidity.

There is no question but that forests reduce the extremes of temperature in their immediate neighborhood. They also serve mechanically as windbreaks, diminishing the force of air-currents. In these and perhaps other ways they serve a useful purpose.

But with all this in mind, is it worth while to go on planting trees for their climatic effects? It seems to me, that, apart from the uselessness of it, nature is planting trees at an infinitely more rapid rate than man. For every tree planted under the timber-culture act, or on Arbor Day, a thousand spring up of their own accord. Every deserted farm east of the plains grows up to forest. Half of southern New England is to-day wooded, and the proportion is increasing every year, and yet in Massachusetts they have every year an Arbor Day, when the farmers turn out and solemnly plant a tree apiece.

MENTAL SCIENCE.

The Psychology of Deception.[1]

THE deceptive character of the evidence of the senses has become attributed to them because of the failure to recognize that we seldom have to do with a simple sensation. What deceives is not the information of the sense, but the wrong interpretation of this information by the mind. Such interpretation need not be conscious, and often is not so. The familiar experience of raising a pitcher of water, usually well filled but upon the present occasion empty, and finding it dart upwards in our hands, is a case in point; for it shows that we estimate the amount of force necessary to raise the pitcher, but only become conscious of this inference when it happens to lead us astray. The phenomena of the stereoscope abound in illustrations of such unconscious reasonings. One of the simplest types of deceptions arises when such an inference, owing to an unusual disposition of external circumstances, leads to a conclusion that better evidence shows to be false. A ball held between two crossed fingers seems to be double, because under ordinary occasions an impression on the right side of one finger and on the left side of its neighbor (to the left) could only be brought about by the simultaneous contact of two objects. Everywhere, then, we interpret the unfamiliar by the familiar, the unknown by the known: illusion arises when the objective conditions change their character, and real deception occurs when this change is not recognized, when no better evidence is present to antagonize the false inference. The child who regards a spoon half immersed in water as really bent,

[1] See an article with this title by Joseph Jastrow, Ph.D., in the *Popular Science Monthly*, December, 1888.

the moon high up in the sky as really smaller than when near the horizon, presents a case of such deception.

No better instances of deceptions depending upon unusual objective arrangements can be found than the ordinary conjuring tricks. Here deception depends solely upon an ignorance of the devices employed. When ink is turned into water, when two half-dollars are rolled into one, when a box in which you have just placed an article is opened and found to be empty, or when a card suddenly changes from one face to another, deception takes place when the spectator is ignorant that a chemical can change the color of liquids, that one half-dollar is hollow and allows the other to fit into it, that the box has a double bottom, and the card a flap, that, falling down, shows another aspect. These objective arrangements are often much more complex, and the conditions that ordinarily lead to correct inferences are imitated with remarkable ingenuity. The accepted rule of conjuring, to always first actually do that which afterwards you desire the audience to believe you have done, shows keen insight into the workings of the mind. When coins are caught in the air and thrown into a hat, a few are really thrown in; the others palmed in the hand holding the hat, and allowed to fall when the other hand makes the appropriate motions.

Leaving the objective conditions of deception, and turning to the subjective, the psychological interest is deepened. If our condition departs from the normal, however slightly, and we fail to recognize the variation, illusion is apt to arise. The phenomena of contrast and fatigue are simple cases in point. Fatigue the eye for red, and it sees white light as green. Plunge the hand from hot water into luke-warm water, and it will feel the latter as cold. When a disturbed mental judgment is present to misinterpret such unusual sensations, illusions of a very serious type may arise. But even within the limits of normal judging powers, the emotions, the interest, expectation, can alter the nature of a sense impression. In all perception two factors contribute to the result,— the attitude of the percipient, and the nature of the object perceived. When the naturalist observes what the stroller overlooks, or the sailor detects a distant sail when the landsman's eye sees nothing, it is because the former knows what to expect. When expecting a friend, any indistinct noise is converted into the rumbling of carriage-wheels, as the mother hears in every sound the cry of her sick child. The conjurer, taking advantage of this, creates an interest in some insignificant detail, and draws the attention away from the real trick. His wand, his motions, his talk, are all intended to give him a favorable moment for doing the real trick before the unobserving eyes of the spectators. When he counts 'one, two, three,' centring all the emphasis upon 'three,' and thus focusing the attention of the audience upon that instant, he does the real transformation at the unattended 'one' or 'two.' The conjurer's art is largely composed of devices for misleading the attention: a trick is successful according to the setting that the performer can give to it.

In one point, however, the conjurer's performance fails to illustrate the psychology of deception. The attitude of the spectator is too definite. He knows that he is being deceived and has nothing at stake. Quite different was it when such a performance carried with it a belief in the magical and mystical, when the spectator believed himself in the presence of powers that could be turned against him and his welfare. The best parallel to this attitude in modern times is seen in the physical phenomena of Spiritualism. The medium performs to sitters in doubt as to the true explanation of the phenomena, or more or less ready to credit every thing to the supernatural. Such an expectation can see a miracle in the simplest conjuring tricks; and more than once have professional conjurers been declared to be mediums in spite of all protests from themselves. The general rule at the séance, where the emotions are strung to the highest pitch, and the judging faculties labor under the worst conditions, is that the spectators see whatever they are interested in seeing. The same form is recognized by various spectators as the spiritual counterparts of totally dissimilar persons. Only let the form be vague, the light dim, the emotions at a strain, and what is lacking in the object will be supplied by the imagination of the spectator. In the same phenomena each finds proof of his own pet beliefs, until the refusal to mistrust the evidences of an excited consciousness leads to actual mental disorder. The records of the witchcraft delusion show the same result: the facts are seen in the light of the prevailing theory. "With the doctrines of modern Spiritualism to be supported, the number of mediums and manifestations will be correspondingly abundant. Create a belief in the theory, and the facts will create themselves."

To all this must be added the enormous influence of mental contagion. Wherever a subjective influence contributes to the resulting deception, contagion plays a part,— fear, panic, fanaticism, superstition, all flourish in crowds. The witchcraft delusion and the spiritualistic movement show to what dimensions psychic beliefs can attain when fanned by the flames of emotional enthusiasm. If, in addition to all this in which self-deception plays the leading *rôle*, we add the variety of illusions carried on by conscious fraud, we may perhaps appreciate the enormity of error through which civilization has made its way. Such errors are destroyed, not by logical disproof, but by rendering unsuitable the soil upon which they flourish.

THE ALLEGED EVOLUTION OF COLOR SENSITIVITY.[1] — To test the theory frequently met with, that in the thirty centuries of civilization the human retina has developed a gradually increasing color perception,— the homeric man seeing chiefly the red end of the spectrum, and blue coming in much later,— M. G. Pouchet compared the proportion of color epithets in types of the literature of various ages. He selected (1) a very recent work of M. Guy de Maupassant on water, (2) 'Paul et Virginie,' as typical of the beginning of the century, (3) Books I. and VII. of 'Telemaque' for the same reason, (4) Chapters XIV. to XXII. of the second book of 'Pantagruel,' taken at random from 'Rabelais,' and (5) a short romance, 'l'Ane,' attributed to Lucian. (1) gave the following number of color appellations: white, 21 times; black, 14; gray, 3; brown, 4; all kinds of reds, 23 (including pure red — 15); yellow, 5; green, 6; varieties of blue, 17 (in which pure blue occurs 12 times); and violet, 3 times; in all, 96 terms. Taking only the primary colors, we have red, 26; blue, 17; green, 6; yellow, 5; and violet, 3. (2), though more extended a work than (1), gave the following: white, 13; black, 15; gray, 1; varieties of red, 11; varieties of blue, 7; of green, 8; yellow, 1: or red, 11; green, 8; blue, 7; yellow, 1. (3) gives black, 2; white, 2; red and shades, 4; green, 2. One might add golden, 2, and reddening, 2; and would thus have red, 6; yellow, 2; green, 2. (4) gives black, 1; white, 3; red and varieties, 7; green, 2; blue, 1. (5) gives but one name, red. The result is that writers show a marked tendency to describe red things, and this tendency holds good for all times. If we survey the ordinary color impressions to which the retina is exposed, we find, first, a general brightness involving all colors,— the blue of the sky, the reds of sunrise and sunset, the whites and grays of clouds; words expressive of these abound. Considering next colors in which whiteness does not enter, we find that a true violet is extremely rare in nature. Blue, too, is little fitted to be physiologically conspicuous as it presents itself in nature. Yellow is more extended, especially on flowers, but it loses its individuality in a general whiteness. There remain green and red. The reason why red has acquired so striking an effect is, that, owing to the preponderance of green, the red is conspicuous by contrast. Again, red, as the color of blood, as the symbol of fire, as the color first and most sought after in dyes, would soon acquire a moral and intellectual prominence that would lead to its frequent mention. The proper conclusion, then, is not that our ancestors were unable to see blue and its allied shades, but that they followed the natural tendency to describe what was prominent, and this coincides with the red.

THE MENTAL POWERS OF THE APE.— According to a recent letter to the London *Times*, Mr. Romanes has succeeded in teaching an ape to count; not merely to detect differences of number, but to associate different groups of sensations with vocal sounds. Fearing that if too complex the experiment would entirely fail, the counting was attempted only up to five. By refusing all but the number of straws asked for, and rewarding the ape for a correct performance, the creature was taught to give at command one, two, three, four, or five straws. His method is to take the straws one by one into his mouth, until one less than the required number have been collected; then, taking up an additional straw, he hands it over, together with those in his mouth,— certainly a remarkable performance.

[1] *Revue Scientifique*, Oct. 13.

ETHNOLOGY.

A Mexican Feather Ornament.

THE trustees of the Peabody Museum of Cambridge have decided to issue in a separate form such special papers as have heretofore been published in connection with the annual reports. The first number of this new publication, which will have the title *Archæological and Ethnological Papers of the Peabody Museum,* has just been issued, and is of great interest. Mrs. Zelia Nuttall discusses the meaning of the widely known Mexican feather ornament in the Vienna Museum of Natural History, which dates back to the time of Charles V. The modest title 'Standard, or Head-Dress,' which she has given to her study, covers, however, an historical investigation of the greatest value. Starting from a consideration of the interesting specimen, she gives conclusive proof that it was one of the head-dresses used by Mexican war-chiefs. In this investigation the authoress for the first time applies her discovery of complementary signs in the Mexican graphic system, which was announced two years ago at the Buffalo meeting of the American Association, to deciphering a certain iconograph; and in an appendix she sets forth more fully the essential features of these signs. A hieroglyph may represent various sound-combinations, as the object represented is liable to be designated by synonymous names. In order to show which name was meant, complementary signs were used, the phonetic value of which determined which word was meant. An arm and hand, for instance, might express *maitl* ('arm') as well as *acolli* ('shoulder'). If above the arm the conventional sign for water (*atl*) is painted, yielding in composition the phonetic value *a*, which is also the first syllable of the word *acolli*, this complementary sign indicates that the latter word is meant. This discovery of Mrs. Nuttall promises to be a great help in the decipherment of Mexican texts. The question as to the real significance of the feather ornament is decided by a thorough investigation of the use of banners and head-dresses in ancient Mexico. The authoress's final conclusions are briefly summed up as follows: The testimony of native Mexican paintings and sculpture, and of early Spanish records, taken into consideration with the evidence furnished by its structure, and also by the appellation bestowed upon it in the Inventory of 1596, in which the first record of the specimen is found, proves it to be a head-dress. Manufactured with the utmost care, of materials most highly esteemed by the Mexicans, uniting the attribute and emblematic color of Huitzilopochotli, fashioned in a shape exclusively used by the hero-god's living representative, the high-priest and war-chief, this head-dress could have been appropriately owned and disposed of by Montezuma alone at the time of the Conquest, from which period it assuredly dates.

TEXTILE PATTERNS OF ANCIENT PERU. — Dr. Alphons Stübel, who, in company with W. Reiss, spent five years in travels of discovery through Peru and other parts of South America, and edited conjointly with him the pictorial work, 'Das Todtenfeld von Ancon' (Berlin, 1880–87), in a volume published at the celebration of the twenty-fifth anniversary of the Dresden Geographical Society, treats on "textile patterns of ancient Peru compared with analogous ornaments of classic art." The various ornaments, consisting of squares, trapezoids, lozenges, circles, etc., give origin to more complicated ornaments by a combination of the same geometrical figures whenever one of these is shoved on to another of the same description by sliding it on below, on the sides, or on any point where both can combine. Stübel's ideas are very original and ingenious, but whether the inventors of these ornaments really obtained the ideas for their multiple patterns in this way is rather to be doubted. The pamphlet is illustrated by a large number of designs, and fully deserves notice.

THE MIGRATIONS OF THE BANTU. — Mr. H. H. Johnson, the well-known African explorer, advances, in a recent number of the Proceedings of the Royal Geographical Society, a suggestive theory of the origin and migrations of the Bantu and their northern neighbors. He believes that their common home was in the region between the Shari and Welle-Ubangi. From this centre, he thinks, emigrants had constantly been starting to the west, and had carried with them their languages, which have given rise to most of the languages in western Africa between the Gambia and the Niger. But there still remained in this district north of the Kongo, east of the west coast watershed, south of Lake Chad, and west of the western affluents of the Nile, two flourishing and nearly allied tribes, whom he calls the Bantu and Semi-Bantu. Later on, both peoples were driven from their homes. The Semi-Bantu proceeded due west towards the Niger, and the Bantu turned to the south and south-east. The Semi-Bantu greatly discarded and wore away the grammatical structure inherited from its mother, and which its Bantu sister developed and perfected, but retained in a great measure its primal stock of word-roots. Mr. Johnson continues, "These tongues, while retaining many roots in common with the Bantu, have a grammatical structure which lacks all, or nearly all, Bantu features. The resemblance in vocabulary to the Bantu increases as you proceed eastward, but is not to be explained by the theory of 'loan-words,' because the similarity of the word-roots strikes too deeply into the language-system." We would be more inclined to conclude from this statement that the 'Semi-Bantu' are mixed languages. "The primitive Bantu tribe," Mr. Johnson continues, "moved away from its original home in a south and south-easterly direction, and probably located itself for some time in the district lying between the Welle, the Kongo, and the Muta-Nzige and Albert Nyanza Lakes. Here, no doubt, it settled down for a while, and throve and multiplied; and here probably it received the ox, sheep, goat, pig, and domestic fowl from tribes to the north, to whom they had permeated from Egypt. Rapid increase and its consequent troubles caused the primal Bantu people to again split up and its sections to part company, and the great Bantu invasion and occupation of the southern half of Africa began to take place. Except the feeble, dwarfish races of Akka or Hottentot and Bushmen, there seem to have been few inhabitants to dispute southern Africa with the Bantu, and from their centre of activity they sent out streams of emigrants westward along the Welle and the Kongo, eastward to the Nile lakes and the Zanzibar coast, and southward to Damaraland and Natal." Although this detailed theory seems to be constructed on rather slight evidence, it is an interesting attempt at explaining the complicated ethnological phenomena of Africa.

ELECTRICAL SCIENCE.

Electric Street-Railways.

THE next three months will determine whether there will be rapid advance in the equipment of electric street-railways, or whether they will have a decided set-back. There have been roads equipped in New England during the summer that will have a severe test this winter, and there are few places where the equipment will not have to do heavier work than ever before.

At the beginning of the year the Sprague Electric Railroad and Motor Company did not have a car running; the Thomson-Houston Company — then the Van Depoele Company — had half a dozen roads in operation; the Daft Company, about as many. To-day the Sprague Company has thirty roads completed or in course of construction; the Thomson-Houston Company, about as many; the Daft Company, perhaps a dozen; with a number of other systems represented by single roads in different localities.

There have, too, been radical changes in the methods that were used only a short time ago. The Thomson-Houston truck, with the motor pivoted on the axle and gearing direct to it, is a very different affair from the Van Depoele motor placed in a compartment in the car, driving the wheel-axle by a chain belt. The Sprague Company have also gained something from experience; and the last type of motor and gear with the single magnetic circuit, the admirably simple method of reducing the speed, and with the new brush for the commutator, is a marked improvement on the type they have been building.

It is significant, that, with a few exceptions, the method used to convey the current to the car is by an overhead wire. The question of street-car propulsion is mainly one of economy, and it is but natural that horses should be first displaced where the most economical electrical system is allowable. But it will be seen, that, if we are to retain our prejudices against the overhead wires in our city streets, the real problem of displacing horses in city

tramways has not been solved, nor is it much nearer solution than it was a year ago. The ideal system for such work is undoubtedly the storage-battery system, and the experiments that have been made in that direction are few. In Philadelphia a partial test of storage-batteries was made, with the result — as stated before the Street Railway Convention a month ago — that the cost of running a car was nine dollars per day, — about that of horses. In New York the cars on the Fourth Avenue Road are being slowly equipped, but it is too early to obtain even approximate figures as to the cost. A storage-car was run for a few months in Baltimore, and another in Rochester, but nothing has been heard of them for some time.

So that, although a number of roads have been equipped with electricity, yet the work has been in the direction of suburban tramways, and the question of city tramways remains still unsolved. But the important question now is, what will be the effect of snow and sleet on the overhead structures, and on the possibility of propelling the cars? And according as the reply is favorable or not, will the work of next year be satisfactory or otherwise. If there are no hitches other than any system would be subject to, then it is easy to predict that next year the companies engaged in electric railroading will get as many roads to equip as their capacity will allow, for on the question of economy of operation there is no doubt.

It should be the aim, then, of the electric-motor companies to supply every possible means of clearing the tracks of snow and ice. In Boston the Sprague people have constructed a special clearing car with an abundance of power, and with brushes worked by electric motors, for clearing the track, and it is fair to suppose that such an arrangement will be more efficient than a team of horses. It is probable that both this company and others have equipped all of their roads with some such construction-car. If they have not, they will lose by it, for this winter will test electric tramways; and the company that best stands the test will have the most work next year.

THE WESTINGHOUSE COMPANY'S EXTENSIONS. — The growth of the Westinghouse Electric Company in the last two years is one of the remarkable features of the rapid extension of the applications of electricity now taking place. Two years ago the alternating system of electric distribution was practically unknown in this country: several successful installations were in operation in England and on the continent, but it had not been taken up here. The Westinghouse Company purchased the patents of Goulard and Gibbs, and undertook the exploitation of the system with so much energy and success, that to-day they have over three hundred thousand lights in operation. At first they had no fundamental patents on incandescent lamps, under which to operate; but a combination with the Sawyer-Mann interests gave them the protection of the patents granted to Sawyer and Mann, and in the last few weeks they have absorbed that company. Their latest move has been the purchase of the control of the Waterhouse Electric Company, whose system of arc-lighting has many points of merit. Some time ago the Tesla patents for alternating-current electromotors were acquired, and now the Westinghouse Company advertises that they are ready to supply motors for their alternating circuits. It would seem as though this company was gathering its energies for the conflict between alternating currents with converters and continuous currents with secondary batteries, — a conflict that is already at hand. They have very wisely secured control of apparatus that will enable them to use their stations to the fullest capacity possible. They can supply arc lamps, incandescent lamps, and motors from the same station, and the latter will partly compensate for the advantages that secondary batteries offer. It is not probable, however, that in the lighting of crowded city districts they will be able to successfully compete with a direct system of distribution, especially if electric-light wires are ordered under ground, and if storage-batteries are slightly improved. But the field for the alternating system is wide enough to fully occupy the energies of even the Westinghouse Company.

THE ELECTRIC LAUNCH 'VISCOUNTESS BURY.' — The London *Electrical Review* describes, in a recent issue, this launch, — the largest, with one exception, in the world. She will carry eighty passengers comfortably. Her dimensions are 65½ feet long by 10 feet beam, with a draught of 22 inches and a displacement of 22 tons. Her rudder is specially designed with the object of clearing weeds and obstructions. The steering-wheel is forward: adjoining it is an indicator communicating with the electrician in charge of the switches controlling the electrical power. The electrical energy is stored in two hundred of the Electric Power Storage Company's accumulators of the 1888 type, each of which has a storage capacity of 145 ampère hours, with a discharge-rate up to 50 ampères. These cells are arranged one hundred on each side under the seats. The space occupied by them is lined with lead, with small drains leading off, so in case of accident there would be no damage from the acid. It is calculated that the stored energy will propel the vessel for ten hours at six miles an hour. Twin propellers are used, each driven directly by a 7½-horse power Immich motor, making one thousand revolutions per minute. The switches are fixed so that either motor can be worked independently of the other; or they can be driven at half speed or astern. All of the machinery is beneath the flooring, leaving a clear space fore and aft for the passengers.

THE DIRECT UTILIZATION OF THE SUN'S ENERGY. — Many plans have been proposed for the direct utilization of the sun's energy, — Ericsson's heat-engine supplied by solar radiations; the plan of MM. Conova, Piffre, and Mouchot, who proposed to concentrate the sun's rays on a mass of water, which would be turned into steam; with a number of others, none of which have even reached the stage of successful experiment. Mr. Edward Weston proposes, and has recently patented, the idea of using a thermopile, which is to be placed in the focus of a mirror or lens, and which is to be used to charge a storage-battery, from which the energy is finally to be drawn. An electro-magnet in the circuit is so arranged as to cut out the pile when its electro-motive force falls below that of the battery. When we consider the very low efficiency of thermopiles, — not over three or four per cent, — it would appear doubtful whether the plan will ever be more than an interesting suggestion.

BOOK-REVIEWS.

Fifteenth Annual Report of the Secretary of the State Board of Health, Michigan, for the Fiscal Year ending June 30, 1887. Lansing, State. 8°.

IN addition to the statistics and routine reports usually found in official health reports, this volume contains a number of exceedingly valuable contributions to sanitary science. The most important of them is that which describes the investigations conducted in the State Laboratory of Hygiene, under the direction of Prof. V. C. Vaughan. These include experimental studies on the causation of typhoid-fever, poisoning from tyrotoxicon, and an exposure of the stenocarpine fraud. At the time this exposure was made we called the attention of our readers to it. It will be remembered that the announcement of the discovery of a new local anæsthetic was made through the medical journals, to which the name of 'stenocarpine' was given. F. G. Novy, M.St., instructor of hygiene in the State Laboratory, analyzed the drug, and found it to be a mixture of cocaine and atropine. Since the publication of his analysis, nothing more has been heard of stenocarpine, and we are informed that it has been withdrawn from the market.

The cases of poisoning from tyrotoxicon which were investigated were those which occurred at Milan, Mich., in September, 1887. Four persons in one family were poisoned; and of these, three died. Professor Vaughan reports that the sickness was distinctly traceable to milk, in which tyrotoxicon had developed. The milk was kept in a buttery, the floor-boards of which had rotted, so that a second layer of boards was necessary. Between these two floors a great mass of moist, decomposing matter was found, the accumulation of years. When the floor was taken up, a nauseating odor was perceived, sufficient to cause vomiting in one of the persons engaged in the examination.

The experimental studies on the causation of typhoid-fever were made by Professor Vaughan and Mr. Novy, and had special reference to an outbreak at Iron Mountain, Mich., in October, 1887. Attention seemed to be directed to the drinking-water used by the

families in which the disease appeared, and this was accordingly examined. Believing that the ordinary analysis, which consists in the determination of free and albuminoid ammonia, chlorine, etc., would be entirely inadequate, it was decided to inoculate sterilized meat preparations and sterilized milk with the suspected water, and to keep this material at or near the temperature of the human body for varying periods of time, and ascertain whether or not there would be any poisons developed by the bacteria, which were suspected of being in the water. This method was followed, and resulted in demonstrating that the water contained a ptomaine which produced poisonous symptoms; and a cultivation of the micro-organisms in the water upon potato, together with certain physiological experiments, showed that the water contained typhoid bacilli. It has been shown that the fever was brought to Iron Mountain by a man from a railroad construction camp. In commenting on this outbreak, the investigators state that it is well known that typhoid-fever invariably follows dry seasons, and is coincident with low water in wells. There are, on an average, about one thousand deaths and ten thousand cases of sickness from this disease annually in Michigan. These figures can be greatly reduced if people will cease polluting the soil about their houses with slops, garbage, cesspools, and privy-vaults, and will see to it that their drinking-water is pure beyond all question. When there is any doubt, the water should be boiled; but it should be remembered, that, while the typhoid germ most frequently finds its way into the body with the drinking-water, it may be taken in with any food, and even with the air. When a case of typhoid-fever occurs, all discharges should be thoroughly disinfected; and the earth, water, and air about our homes must be pure, if we escape this disease altogether.

The causation of cold-weather diseases is discussed in the report by Dr. Henry B. Baker, the efficient secretary of the board. Although it is a recognized fact that many of the communicable diseases are most prevalent at certain seasons of the year, yet the extent to which their prevalence is controlled by meteorological conditions has not been thoroughly shown by statisticians. This Dr. Baker does by means of tables and diagrams, which exhibit the close relations which diphtheria, small-pox, and scarlet-fever bear to atmospheric temperature. He finds that diphtheria is most frequent in the autumn and winter, accompanying somewhat, in its rise and fall by seasons and by months, the fall and rise of the temperature, and the rise and fall of the velocity of the wind. Small-pox bears a quantitative relation to the atmospheric temperature, rising after the temperature falls, and falling after the temperature rises. Scarlet-fever falls after the temperature rises in the spring, and rises after the temperature falls in the autumn, the sickness changes averaging about one month later than the temperature changes.

The whole report is a valuable one, and reflects great credit on the State board and its officers.

Livy. Book XXII. Ed. by M. T. TATHAM. Oxford, Clarendon Pr. 16°. (New York, Macmillan, 60 cents.)

The Second Book of Xenophon's Anabasis. Ed. by. C. S. JERRAM. Oxford, Clarendon Pr. 16°. (New York, Macmillan, 40 cents.)

Cæsar's Gallic War. Books I. and II. Ed. by C. E. MOBERLY. Oxford, Clarendon Pr. 16°. (New York, Macmillan, 50 cents.)

THREE volumes of this useful series have reached us. The twenty-second book of 'Livy' has been edited by M. T. Tatham. The text is preceded by a brief historical introduction and by a chronological table of the events described in the book. In an excursus the peculiarities of Livy's Latin are dwelt upon; and in the second part, which contains notes to the single chapters, difficult passages are explained. A good sketch-map of the western Mediterranean, on which Hannibal's march from Carthago Nova to Italy is sketched, accompanies the volume. The arrangement of C. S. Jerram's second book of the 'Anabasis' is made on the same plan, the selected book being made complete in itself, without presupposing a knowledge of the general contents of the 'Anabasis.' A sketch of the narrative down to the second book is given in an introduction. This book is also accompanied by a sketch-map showing the march of the ten thousand. Rev. Charles E. Moberly's edition of the first and second books of the 'Gallic War' is illustrated by numerous maps and diagrams. Besides the historical introduction and notes, and hints on the mode of translating Cæsar, it contains an appendix on the Roman military system. The books are printed in very clear type, — an important consideration for school-books, and will be found very useful by the teacher.

A Latin Prose Primer. By J. Y. SARGENT. Oxford, Clarendon Pr. 16°. (New York, Macmillan, 60 cents.)

An Introduction to Latin Syntax. By W. S. GIBSON. Oxford, Clarendon Pr. 16°. (New York, Macmillan, 50 cents.)

THE 'Latin Prose Primer' is intended to be used as a companion to Mr. Sargent's 'Easy Passages for Translation into Latin.' It is designed for the use of beginners. In a number of preliminary exercises, which consist of detached sentences, the pupil is made familiar with the various forms of Latin syntax. The second part consists of aids and explanations for the translation of a part of the 'Easy Passages.' Vocabularies, grammatical notes, and arrangement of the pieces so as to suit the Latin syntax, are given. In an introduction the principal difficulties to obtaining a good Latin style are treated at some length. Gibson's 'Introduction to Latin Syntax' will be found a very handy and useful book. The author does not give a mere collection of rules, but collections of sentences, from which the pupil has to find the rule by induction. Exercises are added to test the pupil's power of applying the rule which has just been arrived at. Separate vocabularies are given for the various parts of speech, the pupils being thus obliged to think before looking out a word, and one of the great disadvantages of dictionaries being thus overcome.

Microscopical Physiography of the Rock-Making Minerals. By H. ROSENBUSCH. Tr. by Joseph P. Iddings. New York, Wiley. 8°. $5.

THE translator of H. Rosenbusch's well-known 'Mikroskopische Physiographie der petrographisch wichtigen Mineralien' has endeavored to present this valuable book in such shape as to be best adapted to the use of colleges and schools. Therefore much of the interesting contents of the original have been omitted, which the advanced student will miss with regret; but the translator has shown good judgment in abridging; and the English edition, as it stands, is a fair general compendium of the subject. Most of the historical portions, which form so interesting a part of the original, have been omitted, as well as the elaborate treatment of the optical anomalies of certain minerals, and many notes on European localities, while a number of notes on American occurrences have been inserted. The book is a translation of the German edition of 1885, and we miss with regret the color-plate of the original, and descriptions of the newest improvements in microscopes. The prefaces to the first and second editions have been reprinted in German. Twenty-six instructive plates of photomicrographs, which formed so prominent a feature of the second edition, have been reproduced here. The translation has been made carefully, and the book, in its English form, will be a useful introduction to the study of the subject, although the advanced student will have to fall back upon the original.

The Ear and its Diseases. By SAMUEL SEXTON, M.D. New York, William Wood & Co. 8°.

IN many respects this work of Dr. Sexton's is unique. It is a wide departure from the beaten path, and contains a large amount of material which has never before, so far as we know, been treated in any one book, and much of it has never before been treated in a thorough manner; the discussions having been confined to medical and other scientific journals. Without attempting to mention all these peculiarities, we would nevertheless refer to some of the most prominent: viz., the influence in producing disease of the ear, of decaying teeth and sea-bathing; wounds and injuries of the ear occurring in warfare and civil life; rupture of the drum-head from boxing the ears, and its medico-legal aspect; concussion from the blast of great guns and explosives; noises in the ears, and their connection with insane hallucinations and delusions; the effects of false hearing on singers, actors, lecturers, and musicians; the classification and education of school-children with defective hearing; the effect of

high atmospheric pressure on the ear in tunnels, caissons, and in diving; and the subject of pension claims of soldiers, sailors, and marines on account of disability from deafness. Dr. Sexton has enjoyed remarkable opportunities for observing diseases of the ear, sixty thousand cases having come under his charge during the past twenty years, and is therefore entitled to speak with authority on all subjects connected with this important organ.

The author first treats of the anatomy and physiology of the auditory apparatus. He regards the theory of audition as set forth by Helmholtz as faulty, and accepts as the true explanation of the process the views of Professor Rutherford, announced by him in a lecture delivered before the British Association, and published in the *Lancet*, Jan. 1, 1887. Rutherford's theory is called by him the 'telephone theory of the sense of hearing,' for the reason that the processes in the two instances are so much alike, and a knowledge of the manner in which the telephone acts helps to explain the function of audition.

We have already had occasion in *Science* to refer to Dr. Sexton's views of the injurious effects of sea-bathing on the ear. Bathers in the surf are liable, when off their guard, to be struck by the waves upon the ear with much violence, especially in boisterous weather at full tide. Cold salt water may thus enter the external auditory canal with sufficient momentum to rupture the drum-head in persons having a large, freely open canal. Swimming or floating upon the back exposes one to the same dangers. There have been 273 patients under Dr. Sexton's treatment for aural disease caused by salt-water bathing, of whom 243 were males, and 30 females. Injury to the ear sometimes follows fresh-water bathing; and in Russian or Turkish baths there is also danger, the bather being at this time extremely susceptible to cold, and consequent catarrh of the upper air-passages.

The author has observed 51 cases of injury to the ear by blows of the open hand or fist, and 16 in which disease was attributable to missiles of various kinds, five being snow-balls.

One of the most interesting portions of the work before us is that which treats of injuries produced by long-continued musketry-fire, by the concussion from the blast of fire-arms and explosives, and by the impact of steam-whistles, metal-hammering, and other intense sounds. A large number of cases are described in detail illustrative of these injuries, many of them having occurred during the war of the Rebellion.

Defective school hygiene Dr. Sexton regards as one of the causes of ear-disease. Much has been written of the ills that arise from breathing foul gas and dust, and very little about the dangers from draughts of air to which pupils are exposed in many schools. Catarrh with aural complications results from this cause.

A large experience has led the author to believe that great injustice is being done in permitting children to struggle for an education, under the disadvantages arising from deafness, without the aid of methods which experience has shown to be advantageous in such cases. He found 76 cases of deafness in 570 pupils examined in the public and parochial schools of New York City; while, of this large number of children, but one was known to the teachers as suffering from deafness, and only nineteen were aware that they were deaf. As a result of Dr. Sexton's labors, teachers are much interested in the subject, and find that deafness explains many cases of supposed 'inattention' and 'stupidity.' The author states that careful estimates show that only five per cent of the population of the United States have normal hearing. He finds deafness to exist to a certain extent among teachers as well.

A chapter is devoted to the effect of high atmospheric pressure on the ear in tunnels, caissons, etc., which contains illustrative cases, some of the injuries being produced in the Hudson River Tunnel, and one in the caisson of the Harlem River Bridge. The injurious effects of unskilful treatment in the removal of foreign bodies from the ear are described. There can be, he says, no more pitiable object than a child, terror-stricken and exhausted with fear, struggling in a frenzied way while the ear is painfully lacerated in unskilful attempts at the removal of a foreign body. This operation should only be done by one skilled in the proper methods.

The claims of soldiers, sailors, and marines for pensions on account of disability from deafness is the topic discussed in the final chapter. Under the present law, thirteen dollars per month (a full pension) is the whole amount allowed for total or severe deafness of both ears, with a proportionate amount for partial loss of hearing in one or both ears. On March 1, 1886, 1,230 persons were drawing pensions for total deafness, and 4,159 for partial deafness, — a total of 5,389. A table is given showing the rates of payment, with the aggregate for each State and Territory. Fifty-nine illustrations and a copious index add much to the value of this excellent work.

Town and Country School Buildings. By E. C. GARDNER. New York and Chicago, E. L. Kellogg & Co. 12°.

THIS book is inexpensive and it is unpretentious, but it is full of valuable suggestions. Our schools, especially in the rural districts, are generally buildings of consummate ugliness and inconvenience. The village carpenter builds them, box-like, and is satisfied. It costs no more, however, to build an attractive and well-arranged school than the opposite, if only the builders are shown how to do it. Mr. Gardner's little book serves this purpose admirably. By cuts and diagrams, and by specific building directions, the subject is presented in an attractive and practical way. The book should be often consulted by district school trustees.

Macmillan's Greek Reader. By F. H. COLSON. London and New York, Macmillan. 16°. 75 cents.

A Latin Reader. By H. J. HARDY. London and New York, Macmillan. 16°. 60 cents.

MR. COLSON'S 'Greek Reader' is an attempt to give a collection of stories in Attic Greek taken from originals. As the Greek authors whose writings contain anecdotes, historical and mythological, which form so suitable a subject-matter for school-exercises, belong to a later period, they do not form a good introduction to the study of the great Attic prose writers. On the other hand, such readers as contain interesting stories, that are taken from any source and turned into Greek, labor under the disadvantage that the material is not original, but a translation. The author has avoided this difficulty by selecting stories Greek in substance and form, but simplified, and adapted to the form of ordinary Attic Greek. The stories are arranged by subjects, not as to their difficulty, but the more difficult ones have been marked by asterisks. A full vocabulary and exercises are contained in the volume.

Mr. Hardy's 'Latin Reader' consists of Latin stories taken from Latin authors and other sources. An attempt has been made to gather compact and intelligible stories, the subjects of which may be expected to interest the average schoolboy. These stories are intended for the ordinary reading of boys who are not yet sufficiently far advanced to read Latin authors continuously. They conclude with some pieces taken directly from the authors which will naturally form the next stage; otherwise all the stories are intended for the lower forms of schools. A useful vocabulary is appended to the book.

NOTES AND NEWS.

THE American Institute Fair, which will close early in next month, attracts attention, as it well deserves, from the resident New-Yorkers and those who visit the city. The exhibition hall, at Sixty-third Street and Third Avenue, is convenient of access by the elevated railways and street-car lines. With the building filled with a variety of exhibits, covering almost every branch of industry, and the machinery hall containing about one hundred different exhibits, and a Corliss engine working without fault, and pronounced by competent judges to be as fine a piece of mechanism as has ever been seen even in New York, and with an art department complete, and household exhibits without number, — and all this at the reduced admission of twenty-five cents, — there is no reason why an investment of money and an investment of time to visit the fair should not be made, and good return received for going. The building is open from 10 A.M. to 10 P.M.

— G. Gröber's *Grundriss der romanischen Philologie* has now arrived at its third number, which completes the first volume. The work, which is published by Trübner at Strassburg, is a cyclopedic collection of grammatic, literary, and paleographic articles upon

the Neo-Latin languages of southern Europe, contributed by twenty-five specialists. The originator and digester of this literary enterprise has evidently secured the best talent obtainable for the purpose, and the wealth of information contained in the 853 pages of the handsome volume is simply overwhelming. The almost infinitely numerous dialects are examined as carefully as the literary form of each Romance language, and whole pages are devoted to the history and literary history of the dialects, and the metrics, stylitics, and philologic transmission of the principal languages from their earlier stages down to our times. Attention was also paid to those extinct tongues which have or may have influenced the formation of the Neo-Latin languages, as Oscan, Umbrian, Etruscan, Celtic, Basque, etc. Prof. G. Gröber, W. Schum, A. Tobler, and others have furnished treatises of more general import upon Romance studies, whereas the French and Provençal was treated grammatically by H. Suchier, Italian by Fr. d'Ovidio and W. Meyer, and Spanish by G. Baist. The second volume will be devoted especially to the history of the different literatures of the Romance tongues.

— Beginning Jan. 5, Prof. W. O. Crosby will give a course of ten lessons before the Teachers' School of Science of the Boston Society of Natural History.

— The Geological Survey of Kentucky has just published a report on Bath and Fleming Counties by W. M. Linney, which is accompanied by a good geological map. A detailed geological description of the counties, and notes on their mineral products, mineral waters, and agricultural resources, are given. An appendix contains notes on the rainfall at Sharpsburg from January, 1859, to September, 1885. The Preston Ore Banks in Bath County are treated at some length.

— The New England Meteorological Society proposes to have a loan exhibition of meteorological apparatus, photographs, etc., at the Institute of Technology, Boston, in connection with its fourteenth regular meeting in January, 1889. For this purpose the society invites contributions of meteorological apparatus, photographs, and charts and specimens. Articles should be sent to A. Lawrence Rotch, Massachusetts Institute of Technology, Boston, by prepaid mail or express, not later than Jan. 12, 1889, and preferably immediately. Communications regarding the exhibition should be marked "Loan Exhibition," and addressed to A. Lawrence Rotch, Blue Hill Observatory, Readville, Mass.

— The American Forestry Congress convenes at Atlanta, Ga., on the 29th of November, and the annual meeting of the Association of Agricultural Colleges and Experiment Stations occurs at Knoxville, Tenn., Jan. 1.

— Notwithstanding the considerable difficulties which have been met with in the digging of a canal to connect the Obi with the Yenisei, and the want of money for the completion of the undertaking, the work of connecting the two great arteries of navigation in Siberia is still advancing. *Nature* says that in the summer of the present year a boat 56 feet long and 14 feet wide, taking 3½ feet of water, was drawn from the Obi into the Yenisei with a load of 40 tons of flour. The two rivers are 630 miles apart.

— N. M. Prjevalsky, the famous explorer of Central Asia, died at Vyernyi when preparing his fifth expedition to Tibet. Prjevalsky, in his four expeditions to Central Asia, has laid the foundation of our knowledge of these remote regions. On his first expedition he explored Mongolia and the country of the Tangutes. The Russian Geographical Society awarded him the great Constantine medal for this expedition; but, however important the results were to the science of geography, they were far excelled by those of the second expedition, on which he rediscovered the Lob-nor. His principal aim in all these journeys was to reach Lhassa. On his third journey, when the obstacles presented by deserts and difficult mountain-ranges were overcome, and the explorer was approaching Lhassa, he had to turn back, as the Dalai Lama forbade him to enter the great Buddhistic capital. On his fourth journey he explored the upper Hoangho, but was unable to penetrate into Tibet. He returned by way of East Turkestan. The object of his fifth journey was to reach Lhassa, and it appeared as though the political situation would be favorable to the enterprise. His untimely death will be regretted by all geographers. Prjevalsky was only in his fiftieth year. His energy and love of travel and exploration were indomitable, and undoubtedly important results would have accrued from his further work. He has shown how to explore the highlands of Central Asia; and, although he himself is gone, he leaves a number of enthusiastic followers, who have accompanied him during his journeys, and who will undoubtedly continue his great work.

— *The Open Court* of Nov. 15 contains a discussion of 'The Marriage Problem,' by Prof. E. D. Cope. —— In the December number of *The Chautauquan* are to be found 'Gossip about Greece,' by J. P. Mahaffy, M.A., of Dublin University; 'Pericles,' by Thomas D. Seymour, M.A., of Yale University; 'Greek Mythology,' by James Baldwin, Ph.D.; 'Sunday Readings,' selected by Bishop John H. Vincent, D.D., LL.D.; 'The Circle of the Sciences,' by Prof. A. P. Coleman, Ph.D., of Victoria University; 'The Indians of the United States,' by J. B. Harrison; 'The Red Cross,' by Charles Barnard; 'The Bessemer Steel Rail,' by J. C. Bayles; 'The Charities of Buffalo,' by J. W. Bashford, Ph.D.; 'Count Tolstoï's Theories,' by Anatole Leroy-Beaulieu; 'The Yankee Privateer,' by Arthur Hale; 'Lost Explorers and Expeditions,' by Lieut. Frederick Schwatka; 'The Moravian Mecca,' by Bishop John F. Hurst, LL.D.; 'Talks on Memory,' by Prof. Wilbert W. White; 'Louisa May Alcott,' by Harriet Prescott Spofford; 'Scientific Temperance' (a symposium of letters from eminent physicians), and 'The Dinner of Callias,' translated from the *Symposium* of Xenophon, besides the usual editorial and C. L. S. C. departments. —— The Saranac and Lake Placid regions of the Adirondacks, as they appear in mid-winter, will be described in the Christmas *Scribner's* by Hamilton Wright Mabie.

— A vocabulary to the first six books of Homer's 'Iliad,' by Prof. Thomas D. Seymour of Yale College, is to be published in March, 1889, by Ginn & Co. This vocabulary has not been compiled from other dictionaries, but has been made from the poem itself. The maker has endeavored to be concise, — to give nothing but what is important for the accurate and appreciative reading of the 'Iliad,' — and yet to show the original and derived meanings of the words, and to suggest translations which should be both simple and dignified. A confident hope is felt that the concise form of this vocabulary will save much time for the beginner in Homer. More than twenty woodcuts, most of which are new in this country, illustrate the antiquities of the 'Iliad.' —— D. C. Heath & Co. have recently issued 'Hodgkin's Studies in English Literature,' which gives full lists of aids for laboratory method (a separate pamphlet is issued for each author); 'Fontaine's Historiettes Modernes,' Vol. I., being short and easy stories for beginners; and 'Van Daell's Leander's Mærchen,' with notes for elementary or rapid sight-reading. The same firm will soon add to their series of French texts for schools and colleges, 'La Belle Nivernaise, Histoire d'un Vieux Bateau et de son Equipage,' by Alphonse Daudet, with 6 illustrations; and 'Bug Jargal,' by Victor Hugo, — both edited by James Boïelle, senior French master at Dulwich College, England; also Scribe's 'Le Verre D'Eau' and Lamartine's 'Jeanne D'Arc' (these last are to be edited by A. Barrere, professor of modern languages in the Royal Military Academy, Woolwich, England); also a translation of Paolo Mantegazza's 'Testa, a Book for Boys,' — a companion book to DeAmicis's 'Cuore.' The translation will be made under the supervision of Prof. L. D. Ventura of Boston, and of the Sauveur Summer School of Languages. —— Messrs. Ginn & Co. will have ready about Dec. 15 a new edition of Allen & Greenough's 'Latin Grammar.' The revision of eleven years since has stood the tests of every-day use; but from the day of its publication the book has been studied to find where it could be made better in either great or little points, and the results of this study are given in the present revision. With Collar and Daniell's 'Beginner's Latin Book,' the new 'Grammar' and the new 'Cæsar,' 'Cicero,' and 'Virgil,' followed and supplemented by Collar's 'Practical Latin Composition' (now in the printer's hands), and the forthcoming College Series of Latin Authors, with many other texts, teachers in this department will find most serviceable Latin text-books.

—'The Old Northwest: with a View of the Thirteen Colonies as constituted by the Royal Charters,' by B. A. Hinsdale, Ph.D., constitutes No. 2 of Mac Coun's Standard Historical Series. 'The Old Northwest' is a guide to the historical facts of State, Federal, and Inter-State legislation in connection with their formation, development, and admission into the Union. —— P. Blakiston, Son, & Co. have just published a second edition of 'Medical Jurisprudence and Toxicology,' a text-book for medical and legal practitioners and students, by John J. Reese, M.D.; and 'The Physician's Visiting List for 1889,' being the thirty-eighth year of Lindsay and Blakiston's 'Physician's Visiting-List.'

LETTERS TO THE EDITOR.

Anemometer Constants.

THE last volume of the *Repertorium für Meteorologie* (Vol. XI. No. 7), just received, contains a paper by Dubinsky ('Vergleichende Verification zweier Anemometer in Hamburg, Deutsche Seewarte, und in St. Petersburg, Physical Central-Observatorium'), giving the results of comparative tests of two Robinson anemometers of very small dimensions, and using for this purpose the two whirling-machines respectively at Hamburg and St. Petersburg.

These experiments are of special interest to the writer, who was himself engaged during the past summer upon similar work for the Signal Service, and used, with the larger anemometers of the service, a very small one for studying certain parts of the problem. In this work the whirling-machine was very large, having an arm twenty-eight feet long, which in later experiments was increased to thirty-five feet. It is not intended at this time to speak further of this work, but to notice in a few remarks the method (pp. 11 *et seq.*) used by Mr. Dubinsky to ascertain a very important correction, and to compare his results with those obtained by Dohrandt (*Rep. für Met.*, Vol. IV.–Vol. VI.), who had already used the St. Peterburg machine in making a large number of experiments upon anemometers of the ordinary sizes.

The two whirling-machines, which are permanently set up in closed rooms, are nearly the same in size; that at St. Petersburg being much like a letter T in form, and adapted to be revolved about the central stem as an axis, carrying the anemometer to be tested on the outer end of one or the other of its horizontal arms, which are about eleven feet long. In the Hamburg machine one arm is quite short, and carries a counterpoise; the other is between twelve and thirteen feet long.

In using such whirlers, there is a tendency of the arm and other moving parts to set up a slow rotation in the air, as a whole, through which they revolve. This movement of the air with the arm is called by the Germans, and aptly so, the *Mitwind*. The determination of its amount is one of the most serious obstacles to overcome in experiments of this kind.

Results seem to indicate a pretty close proportionality of this *Mitwind* to the velocity of the arm: and Dohrandt concluded from his studies that in value it was about 5 per cent of the latter. Dubinsky, working with relatively very much smaller anemometers, though using the same whirling-machine, adopts 7.3 per cent as the correction for the *Mitwind*. The discrepancy in these results is really larger than it appears, when it is considered how much less the small anemometers would tend to generate *Mitwind*, as compared with those used by Dohrandt.

A brief description of the method of measuring the *Mitwind* will aid in understanding the question. For this purpose both experimenters placed close to the path of the whirled anemometer a delicate air-meter, with its axis tangent to the orbit. Its indications during the progress of an experiment give a measure of the *Mitwind*, however, being strongly acted upon by the violent disturbance of the air which immediately attends and follows just after the passage of the whirled anemometer, and which cannot be considered as a true *Mitwind*. The velocity given by the air-meter is no doubt, as Dohrandt points out, much greater than that of the true *Mitwind*.

The treatment by Dubinsky, of this observed velocity, to reduce it to the *Mitwind* velocity, is practically the same, at least in intent, as the expedient resorted to by Dohrandt (*Rep. für Met.*, Vol. IV. No. 5, p. 39), who placed on the end of the unoccupied arm of the whirler a small air-meter, which was thus carried in the path of, but diametrically opposite, the whirled anemometer. The whirling-machine is revolved, first with both anemometer and air-meter in position, and then with the air-meter alone. Owing to a decrease in the *Mitwind* attending the removal of the anemometer, the whirled air-meter registers a larger number of units in the second case than in the first; and the difference, in terms of velocity, is considered by Dohrandt as the *true value* of the difference between the *Mitwinds* in the two cases. Not questioning the correctness of this assumption, a comparison of the difference thus obtained with that derived from the indications of the stationary air-meter shows the latter to be from two to three times the former or presumed true difference. Finally, it is further assumed that the whole observed *Mitwind* and the true are in the same proportion. Or, if v_1 and v_2 are the velocities indicated by the air-meter when whirled with and without an anemometer, and x_1 and x_2 the corresponding velocities of observed *Mitwind*, we have, the velocity of the arm being the same in both cases,

$$\frac{v_2 - v_1}{x_1 - x_2} = a;$$

and the true *Mitwind* is $a \times$ observed *Mitwind*.

In applying this method, Dubinsky whirled both of the small anemometers, one on each end of the arm, and then one alone, using the stationary air-meter for observing the *Mitwind* in each case. This substitution of the small anemometer — an instrument equally influenced by equal winds in a horizontal plane, whatever their direction — for an air-meter not thus influenced, is an important modification of Dohrandt's method, and may serve to account for a part, at least, of the difference found in their results. Dubinsky has, apparently without being aware of its peculiar merits, hit upon what is believed to be a more proper method of investigating *Mitwind* than any heretofore used: that is to say, the *Mitwind* anemometer must be of the same form as the anemometer being tested, as it is evident the instrument used for measuring the *Mitwind* must be influenced thereby in the same manner, and to the same extent, as the instrument whose constants are being determined.

Throughout the tests upon the small anemometers the *Mitwind* was carefully observed by means of a stationary air-meter, and 7.3 per cent of the arm-velocity was adopted as its value at St. Petersburg, 7.6 per cent being the value found at Hamburg. A single experiment only is cited, by which the value of the factor a was determined, and is as follows: —

	v_o Velocity of Arm. Kilometres per Hour.	Contacts per Hour of Anemometer No. 74.	x Mitwind. Kilometres per Hour.
With both anemometers	62.24	60.04	4.91
With No. 74 alone	62.56	60.56	4.68

The paper further states that in the second case, had the velocity of the arm been 62.24 instead of 62.56, the recorded contacts of No. 74 would have been 60.27. Hence we have

	v_o	c	x
	62.24	60.04	4.91
	62.24	60.27	4.68
Differences		0.23	0.23

The author, apparently too hastily, jumps at the conclusion, and places

$$\frac{0.23}{0.23} = 1.00$$

as the value of the factor a, and in consequence applies all of the 7.3 per cent observed *Mitwind* as the correction for that disturbance. It is to be observed that the first 0.23 in the line of differences is in terms of *contacts per hour*, and is not a velocity. Further

uncertainty arises in that the value 60.27 seems itself a little abnormal.

Referring to the equation found for this anemometer on this machine, we have,

$$v = 0.910 + 1.02729c - 0.00076c ,$$

from which, when $c = 60.4$,

$$\frac{dv}{dc} = 0.935.$$

Using this co-efficient to reduce the contacts observed in the second case to those corresponding to the velocity 62.24 of the first case, we have 60.22 contacts as the number per hour. To be accurate, the observed *Mitwind* in the second case should also be reduced to the velocity of the first case. Preserving its proportionality to the arm-velocity, we find its value to be 4.67 kilometres per hour. Hence it seems we should have

	v	c	x
	62.24	60.04	4.91
	62.24	60.22	4.67
Differences		0.18	0.24

Using the co-efficient 0.935 to reduce contacts per hour to kilometres per hour, we have corresponding to 0.18 contacts per hour a velocity of 0.17 kilometres per hour. Hence finally,

$$\frac{v_2 - v_1}{x_1 - x_2} = \frac{0.17}{0.24} = 0.71 = a.$$

The true *Mitwind*, according to this value, would be 5.2 per cent, — a value practically the same as that found by Dohrandt; namely, 5 per cent. Considering that the latter value applies to much larger anemometers than the former, the still outstanding difference is probably due to the point already noted, that in the recent experiments a Robinson anemometer, and not an air-meter, was used. Further light would no doubt be thrown upon the question of the value of the *Mitwind*, if experiments were made in which the stationary air-meter is replaced by a small and very sensitive Robinson anemometer.

It is hardly probable that the *Mitwind* is strictly tangential to the path of the whirled anemometer: indeed, the writer has observed a marked tendency to a spiral motion of the air and air-meters with their axes tangent to the circular paths of the end of the whirling arm, — get, as it were, only the tangential component.

These considerations, it would seem, throw more or less doubt upon the accuracy of the *Mitwind* corrections as obtained by both experimenters, though in each case the results agree very well among themselves. Unfortunately Mr. Dubinsky does not give the numerical relations between the 'contacts' and the revolutions of the cups, by which it becomes possible to make comparisons with anemometers of different construction in this respect.

C. F. MARVIN.

Washington, D.C., Nov. 12.

A Telescope for the New Astronomy.

AS we become accustomed to celestial phenomena, we find a large number of faint appearances, upon the interpretation of which our knowledge of the forces at work depends: for instance, the detection of the carbon atmosphere surrounding the sun, foreshadowed by Archimis in 1875 by the detection of the bright carbon band in the blue in the spectrum of the zodiacal light, inferred by Lockyer in 1878 from a comparison of the solar and electric arc spectra, indicated also by the observations of Schuster at Sohag and by Abney in 1881, and finally worked out line by line by the large instruments and photographic methods of Rowland; or, again, the faint bright lines detected in the spectrum of many stars, affording new ideas both as to the cause of the variability of the stars' light and the classification of stellar spectra as worked out from the study of meteorites by Lockyer. We find also that we are not dealing with constant things: change and change again are the only law. As the gravitational astronomer reaches his conclusions by following the changing positions of the heavenly bodies, so the physical astronomer must watch its ever-changing appearance. Recall to mind the discussion over the well-known comet spectrum, one astronomer averring from personal observation, deserving great respect, that the line belonged to the carbonic-oxide spectrum, while his rival assured us from equally trustworthy sources that it was nothing if not hydrocarbon. Science to-day tells us both were right, a slight change in the density of the gas being sufficient to change the spectrum from one to another. Our knowledge is therefore far from complete till we have substituted the series for the single observation.

But the human eye and the human brain are not sufficient — nay, are sometimes misleading — when complete and accurate detail are desired. Our attention is attracted by the points raised by the current theories of the day; and much is left unnoticed, or, if sought, is missed because one did not know where to look. The history of the discovery of the solar prominences, easily seen, after discovery, by the same observer, using the same telescope with which he had previously been unable to discover their existence, presents an example. Photography to-day supplies a remedy. In the hands of a master skilled both in the manipulation of the emulsion and the dye, its effect is not slight; its advantage, much the same as a balloon would give the voyager in the frozen seas, — showing at a bird's-eye glance what years of travel could not show. By it we may carry our best telescopes and our best seeing into every home and school-room; forming in his very youth the astronomer of the future, who shall work without telescope or observatory; rendering him familiar with those appearances which, not so many years ago, enchained his ancestors.

From its scientific side, of what great value has the chance delineation of the tails of comets been in the hands of Bredechin?

It is not every telescope which is fitted to this end. It must be pre-eminently a light-gatherer, which demands a large-sized object-glass, with the attendant mounting, and yet possess the ease and accuracy of motion of a sylph. It must be of great length, — thirty-five or forty feet, — and yet from end to end have no mass of metal which could produce an air-tremor. Yet such an instrument — the El Dorado of full many an astronomer — to-day grows in the workshop of an English astronomer.

Seven feet in diameter, and of great thickness, is the reflecting mirror; forty feet, its length from end to end. Yet tube it has practically none. Tons in weight, it follows the steady pressure of your little finger. Pedestal it has none, but floats upon its polar axis like a large warship; this polar axis being little else than a large boiler, so arranged, that, "should it be thrown into the sea in a given latitude, it would still point its axis to the pole."

With an instrument of less than a fifth its power, Common's well-known photograph of the nebula in Orion was taken. With one of less than a seventh of its capacity, the nebula in the Pleiades was discovered. The wonders reported from Mount Hamilton show us what we may expect it to disclose.

The instrument is secured to us through the *esprit* of a well-known astronomer. Is it not possible that among the readers of your journal may be found many who would contribute something towards its endowment? Of all our observatories, there is none that is popular. Can we not make the largest glass the world has yet seen popular?

S. O.

Insurance.

Theatres.

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SCIENCE

FRIDAY, NOVEMBER 30, 1888.

THE UNITED STATES CONSUL at Manila, Philippine Islands, has written to the State Department to announce that the disease that raged during the summer at Taytay, about eight miles north-west of Manila, and which subsequently spread to the latter-named city, has subsided, and that there is now little apprehension of an epidemic. This disease was officially declared to be Asiatic cholera. It now appears, that, just before the sickness broke out at Taytay, a large consignment of rice, which had been stored in a damp place and soured, was sold among the native shops of the village by some speculative Chinamen, who had purchased it at very low rates owing to its damaged condition. As far as is known, all who ate this rice were attacked with what was supposed to be cholera. The symptoms attending the first cases were undoubtedly those of ordinary cholera-morbus, but subsequent cases showed the most prominent features of Asiatic cholera. The theory that disease is produced or aggravated by the imagination finds some support in this case. The masses, native and European, seem to live in mortal terror of cholera, which has made fearful ravages throughout these islands; and the first indication of an outbreak fills every one with fear. After the disease at Taytay was pronounced genuine cholera, the daily death-rate increased very rapidly; and, although the village was rapidly quarantined, the sickness spread to Manila, and within a week between sixty and seventy deaths occurred. As the death-rate failed to show the usual rapid increase, the hope gained ground that the physicians might be mistaken, and that what was supposed to be genuine cholera might be an unusually aggravated form of cholera-morbus. At all events, the number of deaths began to decrease a few days later, and the fear that the terrible plague of 1882 was to be repeated has now quite subsided. The total number of deaths in Manila since the disease appeared there late in August is 186.

THE AMERICAN PUBLIC HEALTH ASSOCIATION.

THE Sixteenth Annual Meeting of the American Public Health Association was held at Milwaukee, Wis., Nov. 20, 21, 22, and 23. More than one hundred and fifty members were present, representing almost every State in the Union and the provinces of Canada. The opening address was given by Dr. C. N. Hewitt of Minnesota, the president of the association. An abstract of this will be published in a future number of *Science*. Following the address, a large number of papers were read during the session of the association, to the most important of which we shall refer.

Benjamin Lee, M.D., secretary of the State Board of Health of Pennsylvania, read a paper on 'Memoranda of Visits to the Quarantine Stations of the Atlantic Coast, made during the Summer of 1888.' In this paper Dr. Lee criticises in most unfavorable terms the quarantine stations of New York, Philadelphia, Baltimore, Norfolk, and Wilmington. He sums up the defects of the entire system in the following language: "1. Want of uniformity in quarantine regulations, placing one port at a disadvantage [either commercially or sanitively] as compared with another; 2. Conflict of authority, owing to the methods of appointing officials; 3. Entire lack of appreciation on the part of local legislatures, whether state or municipal, of the importance of the expenditure of considerable amounts of money in order to render quarantines at once efficient and inoppressive; 4. Tendency on part of local civic and sanitary authorities to limit their responsibility to the protection of their own city, reckless of the consequences which may ensue to inland communities if they permit infection, which circumstances render harmless to themselves, to pass unchallenged to the latter."

Dr. Crosby Gray of Pittsburgh, Penn., read a paper on the contamination of the water-supply of a portion of that city by surface drainage. The death-rate in this portion of the city (the south side) was higher than that of the rest of the city, and typhoid-fever had been very prevalent there. An investigation proved that the water-supply drawn from the Monongahela was being seriously, steadily, and increasingly polluted by sewage, factory-refuse, and by bumboat nuisances; and that the epidemic in question had been caused by the sudden downwash, through rainwater surface drainage, of typhoid excrements from certain gulleys far above the intake, the disease having for some time been endemic in those localities in a small way.

In the course of his remarks he called attention to the following facts: "The cash value of a human life to a community has often been computed, and it is a moderate estimate of the average value of the 260 lives lost on the south side, over and above its just percentage of the current death-rate in Pittsburgh, at $1,275 each, or $331,500 together. To this should be added the burial-expenses at $50, or $13,000 in all. But, as for every death there are many ill who recover, it would be a juster estimate to capitalize the sick at ten times that of the death-rate. That would mean 2,600 people ill. The average time these persons would be compelled to remain unemployed would be, say, 30 days. This would give us 78,000 days' work lost. From this deduct 15 per cent for those below the productive period of life, which would leave 66,300 days lost. Averaging the value of a day's work at $1.25, the total loss in productivity would be $82,875. Add a quarter to this sum, on the basis of but 31 cents per day, for otherwise productive time devoted to nursing, etc., that amounts to $20,718 more; to which should be added certainly not less than $2 per case for medicine, i.e., $5,200 more. And finally there should not be forgotten the legitimate profit (say, one-third a day's wages) on its putative product, to wit, all of $27,625 more. These amounts tally $480,918 per annum, which, literally fatal waste, might be stopped once for all by the establishment of an improved water-service, drawing its supply from unpolluted sources one hundred miles off, by the timely and wise investment of this sum for two or three years."

'Yellow-Fever, Panics, and Useless Quarantines, its Limitation by Temperature,' was the title of a paper by John H. Rauch, M.D., secretary of the State Board of Health of Illinois. 'The Canadian System of Maritime Sanitation,' by F. Montizambert, M.D., quarantine officer at Grosse Isle, St. Lawrence River, and 'The Quarantine System of Louisiana, and its Improvement,' by Lucien F. Salomon, M.D., secretary Board of Health State of Louisiana, formed the subjects of papers presented by their respective authors. One of the most valuable papers presented to the association was that entitled 'Garbage-Furnaces and the Destruction of Organic Matter by Fire,' by S. S. Kennington, M.D., president of the Minneapolis Board of Health. He described the Forrestal garbage-crematory in use in Milwaukee, the Ryder in Pittsburgh, the Mann in Montreal and Chicago, and the Engle in Minneapolis, Des Moines, and Coney Island. This latter style of furnace has just been completed at Milwaukee, and was put into operation for the first time during the session of the association. Health-Officer Clark of Buffalo described the garbage-crematory in use in that city, and said that its entire running expenses were defrayed by the lubricating oils extracted, alone; so that even if no market could be found at times, or at all, for the resultant fertilizers, they might at least be used as the furnace's fuel, and thus save coal.

One entire morning session was occupied in discussing the subject of yellow-fever, which was of unusual interest by reason of the epidemics in Jacksonville, Fla., and Decatur, Ala. The following papers were read: 'The History and Administration of Quarantine in Texas, 1887 to 1888,' by R. Rutherford, health-officer of Texas; 'The Outbreak of Yellow-Fever at Jackson, Miss., in September,

1888,' by Dr. Wirt Johnson, secretary Mississippi State Board of Health; 'The Problems of Yellow-Fever Epidemics,' by Dr. Jerome Cochran, State health-officer of Alabama; and 'Some Personal Observations on Yellow-Fever and its Habitudes as Opposed to the Fallacies and Dangers of Personal Quarantine,' by Dr. A. N. Bell, Brooklyn, N.Y.

The paper by Dr. Cochran was one of the best of the entire session, and was most enthusiastically received. Dr. Cochran had just come from Decatur, and his views were the result of years of experience with yellow-fever. It was a concise and pithy statement of his opinions, and any abstract that we could now give would be entirely inadequate. We shall hereafter give a full report of it.

The closing session of the association for scientific business was occupied by the reading of the following papers: 'Tuberculosis, its Origin, Detection, and Control,' by D. E. Salmon, D.V.M., chief of the Bureau of Animal Industry, Washington, D.C.; 'Some Observations on the Origin and Sources of Disease Germ,' by Theobald Smith, M.D., of the Bacteriological Laboratory of the Bureau of Animal Industry, Washington, D.C.; and 'Meteorological Observations as respects Disease Prevalence,' by Prof. W. W. Payne, director of the Observatory, Northfield, Minn.

The interest in many of the papers was greatly increased by illustrations thrown on the screen by lantern-projection.

Chairman C. A. Lindsley of the Lomb prize committee announced the award of the first prize, five hundred dollars, to the essay on hygienic dietetics superscribed with the motto 'Five Food Products illustrated by Practical Recipes.' On opening the sealed envelope, it was found that the successful author was Mary J. Hinman, wife of John J. Abel, now resident at Strasburg, Germany, where husband and wife are attending the university. Of the sixty-nine other essays, not one was deemed worthy of being awarded the second prize.

A resolution was unanimously adopted recommending the passage by Congress of an act to establish a national health bureau in the Department of the Interior.

The following officers were elected for the ensuing year: Dr. Hosmer A. Johnson, Chicago, president; Dr. Jerome Cochran of Alabama, first vice-president; and Dr. F. Montizambert of Canada, second vice-president. The secretary, Dr. Irving A. Watson of New Hampshire, and the treasurer, Dr. J. B. Lindsley of Tennessee, were re-elected. The association will hold its next annual meeting in Brooklyn, N.Y.

SURVEYS, THEIR KINDS AND PURPOSES.

MR. MARCUS BAKER read a paper on the above subject before the National Geological Society of Washington, Nov. 2, 1888. He classified surveys as follows: —

I. Surveys for general purposes, or information surveys: 1. Geodetic; 2. Geologic; 3. Topographic (ordinary and military); 4. Agricultural; 5. Magnetic; 6. Nautical (hydrographic and physical).

II. Surveys for jurisdictional purposes, or boundary surveys: 1. For defining boundaries of nations, states, counties, towns, etc; 2. For defining property boundaries (cadastral, and partition of land for sale).

III. Surveys for construction purposes, or improvement surveys: 1. For constructing works, forts, arsenals, navy-yards, lighthouses, fishways, etc.; 2. For constructing routes of communication, roads, railroads, electric lines, pipe-lines, canals, etc.; 3. For reclamation of land, flood-plains, arid swamps, etc.; 4. For improvement of natural waterways; 5. For water-supply to centres of population; 6. For disposal of sewage from centres of population.

Surveys are of various kinds, are made for various purposes, and the results are exhibited in various ways. The kind of survey to be undertaken in any given case, the mode of conducting it and of exhibiting the results obtained, must depend primarily upon its purpose.

Numerous surveys are now in progress in the United States under the auspices of the general government, of individual States, of corporations, and of individuals. Large sums of money are annually expended upon them, and the outcome is of practical moment to many people.

It is conceived, therefore, that it will be of scientific value and of practical importance to take a general view of surveys, to enumerate and to classify them, and to set forth their purposes. It is of scientific value, because the bringing-together of a considerable number of related facts or phenomena under one general view gives rise to comparison, to study, and to deduction of general principles; and it is of practical importance, because the purpose for which any work is undertaken should be clearly formulated, that the work may be so done as to well and economically serve its purpose.

Surveys must be of various kinds, because they are made to serve various purposes. A classification of kinds is, then, a classification by purposes. The tentative schedule here suggested is one of the various possible modes of classification. Whether better or worse than other schemes of classification, is not important for the present purpose. It may serve for enumeration, and afford the basis for some study of the different kinds of surveys as determined by their purposes.

Now, the purpose of all surveys is twofold: viz., first, to acquire certain information relating to the earth; and, second, to spread this information among the people for whom it is acquired. To disseminate the information obtained among those for whom it has been obtained, the results are set forth (*a*) in the manuscript or printed page, accompanied by illustrations, diagrams, profiles, sketches, photographs, etc., and (*b*) in maps. The results of certain surveys are almost completely exhibited without the aid of maps, while in others the entire result of the survey is a map. Between these extremes we have surveys whose results require joint use of text and map in varying proportions.

In a geodetic survey the results are set forth in the printed text, in tables, and in diagram or sketch of the triangulation. In a topographic survey the result is a topographic map, and, if the survey be purely topographic, the map is the only result. These two kinds of survey, therefore, stand at the two extremes in manner of exhibiting results. In a purely topographic survey all the results are exhibited on the map; in the geodetic survey all the results are exhibited in the printed text and tables.

Surveys may be conveniently grouped into three great divisions: viz., I. Those made for general purposes, or information surveys; II. Those made for jurisdictional purposes, or boundary surveys; III. Those made for construction purposes, or improvement surveys. And these again may be usefully subdivided into several smaller groups, as set forth in the above schedule.

The well-being and prosperity of a community is intimately related to and dependent upon the resources of the region in which it lives. Recognizing this fact, civilized communities study their surroundings and resources, in order, that, by a better knowledge of and mastery over them, they may improve their condition.

The general study of the earth, its size and shape, its structure, its surface form, its surface quality, its forces, is the object and purpose of information surveys. The organization of such surveys is a matter of comparatively modern times, and an accompaniment only of the highest civilization.

When civilized man reaches that stage of development in which he recognizes that his advantage over the semi-civilized or barbarous was due to his better acquaintance with, and mastery over, nature, then was he stimulated to further study and research. Research by single individuals, in private laboratories, led to discoveries of interesting and useful facts and principles. It led, further, to the suggestion of principles of wide application, but which could only be tested by the study of many and widely separated localities. Such study being often beyond the power of the individual, and its outcome being of interest to the entire community in its organized capacity to test, the State took it up, and organized expeditions to travel in distant parts, and collect information for the benefit of the whole community. Such expeditions brought back information respecting distant parts, that served to throw light upon little-understood phenomena at home; to establish principles of higher value than the individual facts from which they had been derived; and led to the establishment of some, and rejection of other, generalizations, based upon a knowledge of only a limited area. The interesting, instructive, and useful facts brought to light by such systematic exploration and general survey showed the

practical importance and value of pushing studies of the earth still farther over all areas, and in greater detail.

From this it was seen that there would come additional isolated pieces of information useful to the world, but especially the discovery of general principles.

Thus arose exploring expeditions; and thus arose great government surveys and international surveys, — surveys organized and conducted systematically to study a great area, and to collect and diffuse information for the benefit of the people.

The general study of the earth as it has advanced has differentiated itself into several special lines of study, and has been classified under six heads, as follows: —

Geodetic Surveys.

The primary object of a geodetic survey is the determination of the size and shape of the earth, or, as is preferable to say in this connection, the geoid. Secondarily and incidentally it accomplishes much besides. It determines with highest precision the co-ordinates, latitude, longitude, and altitude, of prominent land-marks over the surface of a country. But this is not essential to its geodetic character. The earliest geodetic surveys by the French Government in France, Lapland, and Peru, measured bases, executed triangulation, and made astronomical observations, solely to determine the size and shape of the earth.

If a scheme of triangulation were planned solely with reference to the measurement of an arc of a parallel, or an arc of a meridian, then the longest lines and the fewest stations and triangles consistent with the required accuracy would be chosen. If the object were the secondary one, of locating points upon which to base other surveys, then the number, location, and accuracy of location would be made dependent upon this secondary condition.

The distinction here suggested is one not anywhere carried into effect; but by geodetic survey is usually understood a survey in which long lines are measured with high precision, and are accompanied by astronomical and gravity determinations. Measures of gravity, in so far as they contribute to a knowledge of the form of the earth, naturally belong with geodetic surveys. In so far as they relate to density and distribution of matter within the earth, they form part of a geological survey. The methods and instruments used, however, in the gravity, or gravimetric survey, closely ally it to the geodetic survey, of which it properly forms a part. Thus a geodetic survey will serve the double purpose of precisely determining the latitude, longitude, and altitude of points for practical use, and of contributing to the general stock of knowledge respecting the form, size, density, and distribution of matter of the earth. And the conduct of the survey will vary according to the prominence attached by the patrons of the survey to the one or the other of these purposes. A very rigid adherence to the "practical" aspect of the case will lead to the rejection of all plans for work not promising "practical" results, while a more liberal policy will go further, and, in addition to the immediate practical results, will aim to deduce general principles and increase the sum of human knowledge.

Geological Surveys.

While geodetic surveys are concerned with the size and shape of the earth, geological surveys deal with its structure, composition, and history. The well-being of man is most intimately dependent upon his power to forecast the future. To forecast the future requires knowledge of general principles or laws, and these general laws are derived by inference from what has been and is. To read the story of the rocks aright; to interpret their history; to establish the principles, more enduring than the rocks themselves, by which from that which has been may be correctly inferred that which shall be, — this is the great geological problem not to be solved by one geologist, or one survey, or one generation, but by the accumulated results of the studies of many men, through many generations. So conceived, it is clear that the work of the geodesist and geologist will not be finished; their work will not be perfect or complete; but each survey and each surveyor will do more or less of good work or bad as his contribution to the world's knowledge. The greatest and best results of a geological investigation or survey may finally be summed up in the general principles deduced,— principles capable of direct application to practical affairs. May we not hope some day to understand volcanic and earthquake phenomena, and, foreknowing destructive earthquakes, escape the dreaded results?

The answer seems certainly to be worth the seeking; and the seeking must needs be made by studying the earth's crust. This is the field of the geologist and the geological survey.

The clay, the marble, the gold, the coal, the granite, the iron, — these and many more in greater or less abundance, and very unevenly distributed, are useful to man. Are there not other unknown natural products useful to man? The geological surveys should seek them. From the clay comes the porcelain and the bricks; from the marble, lime; and from the coal and iron ore, the steel. Are there not hidden from our view yet many more useful products? It seems highly probable, and therefore wise economy, that the State should, for the common good, systematically collect, publish, and distribute the data and information which render such discoveries possible. That the prosperity of a community depends upon the amount and distribution of its natural resources is so obvious, that the systematic study of them is early entered upon in most civilized communities. Such systematic study is the first, the greatest, and the most important work of a geological survey: it is the foundation, and in many minds is conceived to be the only proper work, of the survey.

The purpose of a geological survey may be defined to be, to collect, to systematically arrange, to publish, and to distribute, useful information respecting the earth in general and its crust in particular.

Respecting information not yet obtained, it may not be easy to decide whether it be useful or useless. Is it of any use to know the geological structure of the region about the north pole? It may be a frozen ocean, or a bleak, rocky region, fabulously rich in gold-deposits, or, —who knows? — perhaps a knowledge of so exceptional a locality may furnish the key that will unlock unsuspected resources at our very doors. A wise policy in the conduct of a geological survey will ever seek useful information; but a wiser one will add to this search a deeper research into the unknown — far beyond the limits of immediate pecuniary returns — for the discovery of principles irrespective of immediate practical application.

Topographic Surveys.

The surface of the earth presents a great variety of forms and features. Land is flat, undulating, broken, hilly, mountainous, swampy, desert, etc. The free movement of men and traffic over this uneven surface is much affected by its form: hence, for the general information of those interested directly or indirectly in travel or transportation, a knowledge of surface form is valuable. Hence arise topographic surveys organized and carried on for the purpose of collecting, publishing, and distributing information respecting the surface forms and features of a country; i.e., respecting its topography.

'Topography' is a word used sometimes in a broad sense to indicate a description of a place or region not very large, and sometimes in a more restricted or technical sense to mean simply the surface form, the ups and downs, the hills and hollows. In the early use of the term, its meaning was the general, unrestricted one. It is now used in both senses. If English catalogues of topographical books are examined, they will be found to consist of lists of local town and county histories, local hand-books, guide-books, gazetteers, accounts of noted buildings and persons, and of events connected with local history. Maps or pictures may or may not accompany such topographical descriptions. This is the early English use of the word, — a use which still survives.

Along with this early use of the word, large-scale maps of limited areas were made, — maps which exhibited the hedgerows and highways, the orchards and ditches, the parks and houses, the streams, stone walls, gardens; in brief, all the minor details of the landscape except the surface form. The features were exhibited usually by conventional signs, but the surface form was not revealed on these maps. The horizontal plan alone appeared. The element of relief was wanting. The scales of such maps, however, were so large, that they permitted the exhibition of a large number of small features; and as such, they were called 'topographic' in distinction from 'chorographic' maps, which, on smaller scales, embraced in

one map a much wider field, from which all minor features had been of necessity excluded.

The value and importance of these topographical maps for military purposes were brought into great prominence during the Napoleonic wars. Napoleon, recognizing their importance and value, gave a powerful stimulus to military surveying. He also clearly perceived the value and importance of representing the hitherto unrepresented element of surface form, and to him is said to be due the introduction on topographic maps of a representation of the relief. Then arose systems of different kinds for showing form as well as feature, and thereafter the exhibition of the relief came to be regarded as essential to a topographic map. Thus the word 'topography' underwent a change, an extension of meaning, — an extension to be followed later by a restriction of meaning. When usage had established that by 'topography' both the form and the features of the surface were implied, then the need of distinct terms expressing these two elements arose. Very soon we find 'topography' being unconsciously used to imply surface form alone, and this unconscious use has now become conscious and established. A new word or phrase is therefore needed to express the features, but we have no such term. Thus at first 'topography' relates to surface features, and chiefly artificial ones, villages, roads, cities, orchards, walls, gardens, buildings of various sorts, etc., and all water bodies; later the term is expanded to mean all these, and in addition the surface form; and finally, before losing this extended signification, it is restricted, and used to signify surface form only. Primarily it related to features only: it is now used to relate to surface form. At the same time the earlier, but not earliest, use survives, and is used to imply both forms and features: hence have arisen apparent disagreement and discussion from confusion of meaning of the word.

The features exhibited on maps called topographic may be conveniently grouped into three heads: (*a*) the water features, — ponds, streams, lakes, etc.; (*b*) the surface form, — hills, valleys, plains, etc.; (*c*) the features constructed by man, — cities, villages, roads, etc.; and, if need be, general terms might be coined to express these three classes of phenomena.

The description of water features would naturally be the 'hydrography;' the description of the form, 'cidography;' and the description of the constructed features, the 'tectography.'

This seeming long digression into the meaning of the term 'topography' is only seeming. As a piece of word-history, it is not pertinent; but, as a prerequisite to a clearly defined comprehension of the subject rather than the word, it is of first importance. The proper conduct of a topographic survey requires a clear understanding of what it is, what it is not, and why it is made. What, then, is the object and purpose of topographical surveys?

The object and purpose of topographical surveys is, as I conceive it, the production of topographical maps, — a definition which, without a definition of 'topographical map,' appears meaningless. But even before defining that particular species of map called 'topographic,' it appears that the aim of the survey is solely to produce a map. Its purpose is not the erection or refined location of monuments, nor the tracing of boundary-lines, public or private, nor the establishment of bench-marks. The doing or not doing of these things does not destroy the essential character of the survey, which is the production of a topographical map, — a map which shall exhibit, with an accuracy and detail sufficient for all general purposes, the relation of the features of a country to one another, and to the form of the surface upon which they are. The erection, description, and location of boundary-marks is the special work of the boundary survey; the erection, description, and precise determination of bench-marks — as permanent reference-marks — is the work of the geodetic survey; while the less precise determination of many unmarked stations for temporary use in map-making is the work of the topographic survey.

The topographic survey, like all others in our first category, — the geodetic, geologic, etc., — is not special, but general. It is not made for the purpose of constructing railroads, though a very valuable aid in projecting railroads. It is not made for the specific purpose of reclaiming swamp-land, or arid land, or flood-plain land; but it furnishes general information essential to a preliminary study and plan for improvement. It is not made specifically for war purposes, though useful for such purposes, and serving as a basis for special surveys for military purposes. It is not made for any one specific purpose, any more than a jack-knife is; but, like the jack-knife, it serves many purposes, even though it serve some of them less well than a special tool constructed for the special purpose.

The outcome of a topographic survey, being a topographic map, should be judged by the map; and the map, being for general purposes, should be judged by the manner in which it serves the general rather than the special purpose. And, further, of two maps, or works of any kind, made for the same purpose, and serving that purpose equally well, that one is best which is the cheapest, — a well-recognized principle, especially among engineers.

In the conduct of a topographical survey, one most important question must be decided in advance; viz., the scale to be adopted. Almost all questions of detail hinge upon this. Large-scale maps permit the exhibition of many and small details, and of the relation of objects to one another, with greater precision than small-scale maps, just as a high-power microscope reveals details not to be seen with lower power. For certain purposes microscopes of only very low power serve best; for others, those of moderate power; and for still others and special purposes very high powers serve best. So, also, for many purposes maps of small scale are desirable; for others, maps of moderate scale; while for other and special purposes maps of very large scale serve best. What the best scale is for general purposes has been the subject of very animated and even heated discussion in European countries, particularly in England, where, in connection with the Ordnance Survey, the "battle of the scales" was fought with great vigor some thirty-five years ago. And, as is apt to be the case in such controversies, there were good reasons on both sides, — good reasons for making the scales large, and other good reasons for making them small. The best scale to adopt, therefore, all things considered, was a matter of judgment, and hence the diverse views.

There seems to be no better way of getting at general opinion upon the subject of scales than to see what, as a result of study and experience, various map-making nations have adopted.

The following table, therefore, is presented, showing the scales upon which fourteen foreign states are constructing, or have constructed, general topographic maps of their areas: —

PUBLICATION SCALES OF STANDARD TOPOGRAPHIC MAPS OF FOREIGN STATES.

India	1 : 253,440
Russia	1 : 126,000
Germany	1 : 100,000
Norway	1 : 100,000
Portugal	1 : 100,000
France	1 : 80,000
Austro-Hungary	1 : 75,000
Great Britain	1 : 63,360
Sweden	1 : 50,000 and 1 : 100,000
Italy	1 : 50,000
Spain	1 : 50,000
Denmark	1 : 40,000 and 1 : 80,000
Switzerland	1 : 25,000 and 1 : 50,000
Belgium	1 : 20,000 and 1 : 40,000

These scales all cluster around one mile to an inch. In countries of small extent and of dense population the scales are larger. In countries of larger extent and sparser population the scales are smaller. The lesson taught by this table is conceived to be of great value in determining the scale or scales that should be adopted for a general topographical map of the United States.

A statement recently published, that "maps upon a scale of less than two inches to one mile are of but little use for definite purposes," is therefore an individual opinion, which contrasts with the general opinion in such matters, as inferred from the scale in use by nations conducting topographic surveys.

Topographic surveys may be conveniently classified under two heads having reference to their purpose. If made for general use and information, they constitute the ordinary or usual topographic survey; while, if made for war purposes, they are military topographic surveys. Most of the great militant nations make special surveys and maps, which are unpublished, and are kept secret in the archives of the War Department. The changes in the mode of conducting wars incident to improvement in fire-arms and explosives necessitate corresponding changes in the military maps.

Agricultural Surveys.

Special studies of the character and distribution of soils, and of related phenomena having an immediate bearing upon the cultivation of useful crops, are known as agricultural surveys. The classification of land into groups, as desert, grazing, mining, forest, swamp, etc.; the classification and properties of various soils, as marl, loam, sand, clay, hammock, adobe, etc.; the study of climate as related to crops; the study of animal life, and especially the distribution of animal life, beneficial or injurious to agriculture, — all these, with related phenomena, involve special examination and study in the field, and together form the special work of the agricultural survey. The special results of the distinctively surveying part are classification and distribution, — results exhibited on maps — or topographic maps — prepared for general purposes. The work carried on, and the results obtained, at agricultural experiment stations, are an important, indeed essential adjunct, but do not of themselves constitute an agricultural survey.

Magnetic Surveys.

The earth is a magnetic body. When magnetized bodies, such as compass-needles (free to turn horizontally) or dipping-needles (free to turn vertically), are so suspended as to yield to the influence of the magnetic earth, they move in response to its magnetic force, and take up certain positions or directions. These directions vary with time and with place; also the intensity of the magnetic force exerted by the earth is found to be different in different places, and not to be constant at the same place.

Magnetic surveys are therefore organized to obtain observations of these magnetic phenomena in various places and at divers times, to study them, and to publish the results for general information, the purpose being twofold: viz., first, to ascertain for the general and practical use of persons using the compass, etc., magnetic declination or "variation of the compass" at any point of the earth's surface at any time; and, second, the observation and study of all terrestrial magnetic phenomena with a view to the perfection of a theory whereby all such phenomena may be predicted. As already suggested, the magnetic declination varies with time and with place; the dip also varies with time and with place, and the force varies with time and with place. A knowledge of the declination is of immediate practical use to many people; a knowledge of the dip and intensity, however, is of less immediate practical utility. But for a bettering of our knowledge of the whole subject of terrestrial magnetism, for the establishment of principles respecting it, all its manifestations should be investigated by the magnetic survey.

If a magnetic survey of a State were undertaken for the purpose of producing an isogonic map, or map showing by curves or shading the declination at all points in the State, for the practical use of compass-users, different plans might be used for the purpose.

A few stations widely separated and scattered over the State might be selected, and a precise determination made at each by using sufficient time, care, and delicacy of instrument. This would give refined results and few stations.

On the other hand, by using much less time at each station, and less delicate instruments, more stations could be occupied, and a greater number of less precise determinations obtained in the same time. This latter would have the advantage of showing distribution better than the former.

For showing distribution of rainfall, it would seem that observations at five hundred stations, giving results accurate within one or two inches, would be for many, if not for most, purposes better than the results from fifty stations accurate within one or two tenths of an inch, or ten times as accurate as the former. Similarly, if for the purpose of constructing an isogonic map we have our choice between determinations of declination at one hundred stations accurate within one or two minutes, and determinations at one thousand stations accurate to within ten to twenty minutes, it may not be easy to decide which to choose. Surveys have been tried in the United States by both methods, neither of which completely satisfied the parties conducting them. The latter method has not been sufficiently tested experimentally to prove its quality. But, for the purpose of producing an isogonic map for a given epoch, the writer considers it better to go rapidly over the area to be mapped, securing a very large number of observations at many stations and of only a moderate degree of accuracy, than to have highly refined and precise measures made at only a few stations.

Nautical Surveys.

As the object and purpose of a topographical survey is the production of a map, so the object and purpose of a nautical survey is the production of a chart. Such has been the only purpose until recent years, when the ocean, its movements, its inhabitants, its depths, have become subjects of special study. This special field, under whatsoever name included, — whether 'ocean physics,' 'thalassography,' or 'physical hydrography,'— is only indirectly and remotely connected with nautical surveying as usually understood: hence we may regard the term 'nautical surveying' as embracing ordinary hydrographic and physical hydrographic surveys; the object of the first being chart-making, and of the second an investigation of the oceans and great water bodies for purposes connected more or less indirectly with navigation. The chart produced by the nautical surveyor is usually supplemented by some form of directory, or hand-book, or coast-pilot, giving certain data useful to the mariner in addition to that afforded by the chart.

Similarly, the map produced by the topographic surveyor may be usefully supplemented by some form of guide-book, gazetteer, or geographical dictionary, affording certain useful data supplemental to that contained on the maps.

Tidal observation and current observation form proper parts of ordinary nautical surveys. The purpose of such observations is the immediate and direct one of aiding navigation: hence the selection of stations, and the character and extent of the observations, will be made to accomplish this purpose. If, however, the tidal observations are made for obtaining data whereby the theory of the tides may be perfected, if the current observations are made to discover the general laws of oceanic circulation and their results, then these considerations will lead to a choice of stations and methods, and amount of observation, which gives promise of best serving that purpose.

We have now briefly reviewed and commented on six species of information surveys, — geodetic, geologic, topographic, agricultural, magnetic, and nautical. These surveys are all national works, covering wide areas and long periods for their execution. Moreover, most of them cannot be done once for all, but must be repeated from time to time. The best and completest and most perfect work of the eighteenth century does not satisfy the demands of the nineteenth; and the surveys of the nineteenth will serve their purpose, even if the twentieth century finds it necessary for its purposes to make new and better surveys. The object of a survey is not the attainment of the highest possible precision. Great accuracy is needful for the accomplishment of certain purposes. Such accuracy, however, is not itself the purpose: it is only the means to the end. What the purpose of information surveys are, we have tried to set forth. If correctly set forth, these purposes will furnish the criteria for judging of the precision which should be striven for in any work; and it will thus appear, that, if an accuracy less than the greatest will serve a specified purpose, the greatest accuracy and the cost of securing it are unnecessary. The work done should be sufficiently good for its purpose.

Boundary Surveys.

The second great division in our enumeration consists of boundary surveys, and these may be conveniently grouped under two heads: first, those lines which separate communities or jurisdictions, such as towns, counties, states, and nations; and, second, property boundaries, or boundaries of private ownership. Perhaps the terms 'public boundaries' and 'private boundaries' might be used to indicate these two groups.

Boundary surveys differ from information surveys in this: they deal with lines, information surveys deal with areas. The problems presented by the boundary survey are generally more definite and explicit than those of surface surveys, and there is correspondingly less opportunity for display of judgment and skill in their conduct.

The purpose of a boundary survey is to mark out a line on the earth's surface. As the marks placed by such survey are subject to loss, removal, or obliteration through neglect or malice, it is es-

sential that a record be made giving all needful details for restoring lost marks. The making of the record, however, though an important matter for practical reasons, is a secondary matter to the surface marks which define the boundary. It is the loss of the ground marks, and not the loss of the record, that makes boundary re-surveying necessary. Few if any boundaries are ever so perfectly or completely marked out that subsequent surveys are not necessary. Much of the work of the boundary surveyor, therefore, consists in the retracing of lines, or, what is the same thing, the recovery of old marks. The law, decree, or what not, which prescribes the boundary is the guide for the first survey. Subsequent surveys have the same law and the old notes by which to recover the line as first marked. And as successive surveys, more or less well or ill done, in the course of years accumulate records of more or less obscurity, the work of the surveyor comes to be more and more a study of law and the untangling and interpretation of records.

The language defining a boundary is often such as to be incapable of interpretation, or it prescribes impossible conditions. The north-eastern boundary of Massachusetts has been, and the south-eastern boundary of Alaska may be, in dispute for the same reason. Each requires a line parallel to the winding of a coast or stream.

The partition of the public lands for sale is a particular case of boundary-surveying. These surveys, executed in the wilderness in advance of settlement, were for the purpose of staking out the ground for farmers.

From the nature of the case, much of this surveying was rough and poor. But though roughly and badly done, though the quarter-sections often differ materially from the one hundred and sixty acres, though the rough records show illiteracy or are obscure, nevertheless, whenever the staking-out of the lines on the ground was well done, the survey was well done, for it achieved its chief purpose. But in many places the staking-out was badly done or not done at all; a burnt match passing for a charred stake, and a pebble for a stone monument. In such places the local surveyor will find employment in recovering old land-lines.

The importance of having boundaries well and clearly defined need not be dwelt upon. The perpetual litigation over property boundaries, the litigation in which decisions involve question of boundary, the irritation and occasional wars between nations over boundary questions, sufficiently emphasize the importance of such surveys. The practical need is not merely that a boundary-line should be once surveyed and marked, but that it should be continually marked. The lines should be therefore re-examined from time to time, and lost marks renewed. It appears obvious that such work should be continuously in charge of an officer or little corps of boundary surveyors, who, in an office for the purpose, accumulate the records of all boundaries under their jurisdiction, and who are charged with the maintenance of boundaries. The general government might appropriately undertake the task of marking and maintaining the boundaries of the States, while the individual States might assume control of all boundary-lines within the State. The successful and economical mode of performing such work would seem to consist in abandoning the job or contract system, and substituting a permanent organization, — an organization in which special aptitude, special knowledge, experience, and fidelity would be required. Entrance to such an organization should be solely on account of such qualities, and permanence of tenure in such work is essential to its success. Under such a system, both the States and the United States can economically undertake the work of establishing and maintaining their ancient land-marks.

Improvement Surveys.

The last great division in our classification is that of surveys made as a preliminary or basis for the construction of works or improvement surveys. These surveys may be generally characterized as special. They are made for some one specified purpose; and that purpose, being construction of some sort, almost if not quite universally demands large-scale maps. All improvement surveys may be regarded as 'special' in distinction from 'information' surveys, which are made for general purposes. The general survey is therefore the natural and economic forerunner of, but not a substitute for, the construction survey.

If a canal or railroad is to be constructed to connect the Gulf of Mexico with the Pacific Ocean, a general topographic map of the region exhibiting the drainage and surface form would at once narrow the question of location down to a very few alternative propositions, or might even completely determine the location. But such general map, even if on a very large scale, and very detailed and very accurate, does not obviate the need of construction surveys. The construction of railroads from the south-eastern Atlantic seaboard into and across the Appalachian Mountain system into the Mississippi basin, is greatly facilitated by the aid of general topographic maps,— maps which, even on moderate or small scales, obviate almost or quite completely the need of trial or random lines or preliminary surveys. To attempt to make a general topographic map with such minuteness of detail, with such precision and on such a scale as to permit its economic use for construction purposes, is to undertake a work that will in general fail of its purpose: construction surveys will still be needed. The information survey affords the material for intelligent and economical planning of improvements; the construction survey furnishes the working drawings and details. The information survey for general purposes takes cognizance of the larger and more permanent features; the construction must take account of much smaller and more ephemeral features. And because construction surveys require information respecting ephemeral features, it is not economical to have such surveys completed long in advance of construction.

As the scale of a general topographic map is increased, the amount of detail shown is increased. And it is possible so to enlarge the scale, and so to multiply the amount of detail shown, as to lay plans for improvements with great definiteness, and even in some cases to begin simple construction works without further information than that afforded by such maps. But, by reason of rapid change of small features, construction must in general follow very quickly after the execution of the survey; and the usefulness of the maps for most purposes declines rapidly with the lapse of time. Large-scale and detail maps of the suburbs of growing cities and towns become quickly antiquated: they serve temporary needs, and are replaced by new ones similarly serving temporary purposes. This being the case, good economy requires that they be made quickly and cheaply.

As topographic maps on very large scales may be made in certain cases to a limited extent for construction purposes, the purposes of topographic surveys, and of surveys for constructive purposes, are sometimes confused. Some engineers demand that a topographic map shall not only serve the general purpose of giving topographic (that is, eidographic) information, but shall also give all details needful for completely planning the construction of works. Such demand implies a confusion of the purposes of information surveys as above set forth,— a confusion through which nearly all map-making nations have passed. Topographic map-making on any extended scale is comparatively new in this country, and the general ideas prevailing respecting them are those which were held in Europe forty or more years ago. At that time it was held that a single map could be made to serve all purposes; and this, of course, required large scales. Then the work progressed slowly, and became very expensive. Moreover, such maps very soon fell in arrears, and were presently hopelessly in arrears. Out of this experience was slowly evolved the principle that maps, and the surveys needful to make them, should fall in three great categories: viz., (*a*) general or chorographic maps, i.e., on a small scale (from $\frac{1}{200000}$ downward), covering the grand features of an area of considerable extent; (*b*) special or topographic maps, i.e., maps on moderate scales (from $\frac{1}{200000}$ to $\frac{1}{20000}$), covering a correspondingly smaller area, and exhibiting all the natural and prominent artificial features of which the scale admits; and (*c*) very large scale plans or diagrams (from $\frac{1}{20000}$ upward), such as parish plans, town plans, cadastral maps, or land-office plats, etc. Between these categories, sharply defined lines do not exist. But the experience of the European nations has in the course of time brought clearly to view the practical importance of differentiating these three classes. And so it has happened that nations formerly making a general topographic map on very large scales are now making them, or have completed them, on greatly reduced scales.

We have subdivided construction surveys into six groups, which

do not need special characterization. The special purpose of each is indicated by its name. The special mode of conducting each for accomplishing its purpose will depend upon many details beyond the scope of this discussion.

HEALTH MATTERS.

Distribution of Consumption in New Hampshire.

THE extent and distribution of consumption in New Hampshire are admirably set forth in a paper by Dr. Irving A. Watson, the secretary of the board of health of that State. The prevalence and fatality of this disease are illustrated by a number of diagrams. From the figures quoted by the author of the paper, it appears that during the three years 1885–87 there were in the State 2,432 deaths from consumption. It is interesting to compare with this the deaths from other forms of disease. From heart-disease there were 1,536 deaths; pneumonia, 1,526; apoplexy and paralysis, 1,421; old age, 1,347; cholera infantum, 918; cancer, 637; typhoid-fever, 464; diphtheria, 411.

From a careful study of consumption in New Hampshire for the past six years, but more especially from the registration returns of the years 1885, 1886, and 1887, the following conclusions are arrived at: —

1. The disease prevails in all parts of the State, but is apparently influenced by topographical conditions, being greater at a low elevation with a maximum soil-moisture, than in the higher elevations with a less moist soil. The prevalence of other diseases also affects the death-rate from consumption.

2. That the season has only a small influence upon the mortality from this disease. The popular idea that the fatality is greatest in the winter is shown to be erroneous, the greatest number of deaths occurring in May.

3. That the mortality is considerably greater in the female sex.

4. That no age is exempt from this disease, but that the least liability of its development exists between the ages of two and fifteen, and the greatest between twenty and thirty. Advanced age does not assure any immunity from the disease, as is generally supposed, but the smaller number of decedents is due to the fewer living persons of that advanced period of life.

5. The death-rate from pulmonary consumption is relatively much the larger among the foreign-born.

6. The average death-rate from consumption for the years 1885, 1886, and 1887, is 12.86 per cent of the total mortality of the State. In Massachusetts, for the ten years ending 1886, deaths from consumption averaged 16.10 per cent of the total mortality; and in Rhode Island, for a period of twenty-five years, ending 1884, 16.30 per cent. This shows a greater freedom from the disease in New Hampshire than in the two States mentioned.

ALCOHOLISM. — Dr. Lewis D. Mason discusses, in the *Quarterly Journal of Inebriety*, the etiology of dipsomania and heredity of alcoholic inebriety. He has collated a large amount of testimony bearing on this subject; and from this, and from his own experience, which has been very large, he draws the following conclusions: first, alcoholism in parents produces a degenerate nervous system in their children, and subjects them to all forms of neuroses, — epilepsy, chorea, paralysis, mental degeneracy, from slight enfeeblement to complete idiocy and insanity; second, alcoholism in parents produces a form of inebriety in their children known as dipsomania, which in the large majority of cases is inherited in the same manner that other diseases are inherited, and we can with propriety and correctness use the term 'alcoholic or inebriate diathesis' in the same sense that we use the term 'tubercular diathesis,' or other terms indicating special tendencies to other inheritable diseases.

TOBACCO-SMOKE AS A DISINFECTANT. — It has long been a cherished theory, at least of smokers, that the fumes of tobacco were to a certain degree disinfecting in their action. To put this theory to a test, Dr. Vincenzo Tessarini, of the University of Pisa, has recently conducted an investigation into the action of tobacco-smoke upon micro-organisms. He devised an apparatus consisting of two funnels placed with their mouths opposed, and sealed with paraffine. To each small end of the funnels tubes were attached, suitably arranged so that a cigar could be placed in one end, while the bacteriological smoker inspired at the other. The smoke was thus drawn into the large space made by the funnels, in which was a plate with various cultures of micro-organisms; control cultures were also used. The microbes were subjected to the smoke for from thirty to thirty-five minutes, during which time from $3\frac{1}{2}$ to $4\frac{1}{2}$ grams of tobacco were used. The micro-organisms tested were the *spirillum choleræ Asiaticæ, spirillum* Finkler and Prior, *bacillus anthracis, bacillus typhi abdominalis, bacillus pneumoniæ, staphylococcus pyogeneus aureus*, and *bacillus prodigiosus*. The kinds of tobacco used were the large Virginia cigars, the large Cavour cigars, the small Cavour cigars, the best cigarette tobacco. The results show that tobacco-smoke has the effect of preventing the development of some micro-organisms entirely, and of retarding that of others. The Virginia cigars seemed to have the most powerful effect, while cigarette-smoke had only a retarding influence, and did not entirely check the growth of any form. By first drawing the tobacco-smoke through water, it was found to have lost its germicidal properties.

FATIGUE FROM USE OF THE TELEPHONE. — At the meeting of the American Otological Society in Washington, Dr. Clarence J. Blake of Boston read a paper on the influence of the use of the telephone on hearing-power. He thinks that this influence must be injurious, because the extremely low intensity, as demonstrated by experiment, of the sounds to be caught from the telephone, compelled a strain of the ear which soon fatigued it, and made it especially liable to injury by the accidental sounds of comparatively high intensity, which were constantly liable to be heard. Dr. C. H. Burnett said he had seen several patients who believed that the continued use of the telephone had impaired their hearing. Dr. O. D. Pomeroy gave the case of a patient who said the use of the telephone fatigued her very much, and she thought had made her decidedly worse.

DISINFECTING LETTERS. — The *American Analyst* describes as follows the method adopted by the United States Government for the disinfection of letters coming from districts in which yellow-fever prevails. Letters from the stricken section are fumigated in a novel way, so that there is little or no chance for the disease being brought northward. The letters are all stopped when they reach the quarantine lines. Each letter is put under a machine with a long arm attached, and this is provided with little teeth punctured at the ends. A powder that is used for fumigating purposes is forced through the arm and down through the teeth. The arm comes down on each letter, and, while the little teeth are perforating the letter, the powder is blown in between the sheets, disinfecting the letter thoroughly. We had understood that after the perforations were made the letters were exposed to the fumes of burning sulphur. If the *Analyst* is correct in its statement, it would be a satisfaction to know what the powder is which thus disinfects the letters so thoroughly. So far as we know, there is no powder which has this power when employed in the manner described, and, until we receive further information, we shall look upon the whole process with distrust.

CIGARETTE-SMOKING. — The poisonous effects of cigarette-smoking have been experimentally determined by William L. Dudley, M.D., professor of chemistry in the Vanderbilt University at Nashville. He describes his methods in the *Medical News* of Sept. 15, 1888. The fact that cigarette-smoking produces physiological effects differing to some extent from those of the cigar led him to make his experiments. The frequently ascribed causes of the difference — that of the adulteration of cigarette tobacco with opium and other drugs, and also the presence of arsenic in the paper — are for many reasons unsatisfactory and insufficient. It is true, no doubt, that the tobacco in many of the less expensive brands is adulterated with cheap drugs and artificial flavors, and that in the more expensive grades opium may be used; but it is equally true that many cigarettes are made of tobacco which is free from sophistication. The presence of arsenic in the paper is entirely out of the question. There is a difference in the methods of

smoking a cigarette and a cigar or pipe. In the two last mentioned the smoke is simply drawn into the mouth and expelled directly therefrom or through the nose, while the experienced cigarette-smoker will inhale the smoke; that is, draw it to a greater or less extent into the air-passages, and in some cases to the greatest depth of the lungs, and thus the absorption of the carbonic oxide and other gases will take place very rapidly, causing more or less deoxidation of the blood, and thereby impairing its power to build up the wasting tissues of the body. Acting upon this theory, Dr. Dudley proceeded to experiment on animals, and obtained for the purpose some mice. The animal to be experimented with was placed in a glass bell-jar, into which the smoke of a cigarette mixed with air could be drawn as rapidly as desired by means of a laboratory aspirator. In the first experiment the smoke was purified as much as possible; and the atmosphere breathed by the animal was practically oxygen, nitrogen, and carbonic oxide. The cigarette was loosely inserted in the end of a tube having two bulbs. These bulbs contained a solution of potassium hydrate to absorb the carbon dioxide and any acids or condensable bodies. A tube was provided containing solid potassium hydrate broken into small lumps, which retained any carbon dioxide that may have escaped the bulbs. The animal was placed in the bell-jar and the apparatus connected together. An aspirator was turned on so as to draw a slow current of air through the apparatus. The cigarette was then lighted, and in twenty-two minutes the animal was dead. On examination of the blood of the animal by the spectroscope, it was found that all of the oxyhæmoglobin had been converted into carbonic-oxide-hæmoglobin, which showed that carbonic oxide was the cause of the death. This experiment was repeated, and the result was the same: the animal died in twenty-five minutes, and the spectroscope revealed the same condition of the blood. A third experiment was made without the bulbs. The tube carrying the cigarette was connected directly. In this case the animal died in six minutes, and the examination again showed that the carbonic oxide was the immediate cause of death, proving that it was the most noxious constituent of the tobacco-smoke. The time required to produce death in the last experiment was about one-fourth that required in the first and second. This was probably due to the fact that in the latter the smoking was done more rapidly than in the preceding, owing to the lessened resistance in the apparatus, and the difficulty encountered in reducing the force of the aspirator. In each case, however, the amount smoked up to the time of death was about the same, — one and one-fourth cigarettes. From these experiments the following conclusions are drawn: 1. That carbonic oxide is the most poisonous constituent of tobacco-smoke; 2. That more injury results from cigarette than cigar or pipe smoking, because, as a rule, the smoke of the former is inhaled; 3. That cigarette-smoking without inhaling is no more injurious than pipe or cigar smoking; 4. That the smoke of a cigar or pipe, if inhaled, is as injurious as cigarette-smoke inhaled; 5. That the smoke from a Turkish pipe, if inhaled, is as injurious as that of a cigarette inhaled.

THE SIGHTSEER'S HEADACHE. — Of the lighter penalties which pleasure entails, none probably is more widely known and felt, or more persistently endured, than the sightseer's headache. It is nature's tax levied on the comfort of that great body of busy idlers to which we all at some time or other belong. In reference to this, the *New York Medical Record* states that it is endemic among the frequenters of museums, picture-galleries, and exhibitions, varying somewhat perhaps in different cases in its precise causation, but associated always in a manner significant of its origin with the habits of the observant loiterer. The circumstances in which it arises afford the most reliable clew to its true character. Among these, temperature, atmosphere, and strain both of body and mind, though commonly combined, play their several parts in varying degrees of activity. The influence of a warm and close atmosphere as a cause of headache is too well known to require more than a passing notice. The torpid congestion of tissue which it tends to induce, and from which the brain is not exempted, is familiar to most of us as a morbid process too often illustrated in our painful experience. It contributes its proportion, doubtless, toward that total of *malaise* which affects the visitor to a crowded picture-gallery or assembly-room, and culminates in the localized ache which renders the slightest mental effort a weariness. The very general prevalence of this variety of headache, however, and its independence in many instances of any vitiation of atmosphere, teach us to look for its explanation in other causes. The effort of mind implied in long-continued observation, even though this does not involve the strain of study, has probably an appreciable though a secondary influence. Fatigue certainly has an important share in its production; but it is with most persons rather fatigue of muscle than of brain. The maintenance of the upright posture during several hours of languid locomotion, the varied and frequent movements of the head commonly in an upward direction, and the similar and equal restlessness of eyes whose focus of vision shifts at every turn as a new object presents itself, form a combined series of forces more powerful in this respect than the sunlight and frequent changes of mental interest and attention by which they are accompanied. The muscular strain implied in these movements is necessarily very considerable. It affects more or less every member of the body; but the distant localization of the resulting ache has probably much to do with the unusual activity of the cervical extensor and rotator muscles, and of the muscles which move the eyeball. Whatever the minor influences at work, therefore, there can be little doubt that mere fatigue is primarily accountable for this most general form of headache, and that rest and nourishment are most reliable antidotes. The utility of stimulants for this purpose is necessarily temporary and deceptive. One improvement on existing arrangements ought to be of real assistance to the suffering sightseer if more generally introduced by responsible authorities. The comparative scarcity of seats in many places of amusement has often been noticed. It would be much to the public advantage if this want were supplied. For the attendants at exhibition-stalls a chair for occasional use is an absolute necessity.

DIPHTHERIA SPREAD BY CATS. — Domestic animals have often not only been suspected but found guilty of spreading infection. In his report on the recent sustained prevalence of diphtheria in Enfield, England, Dr. Bruce Low of the medical department of the local government board incidentally states that during the continuance of the epidemic cats were observed to suffer in considerable numbers from illness; and in December, 1887, and in January, 1888, there was a large mortality among those animals, — so much so, that the attention of the dust-contractor was directed to it. He stated that never in his previous experience had he seen so many dead cats in the dust-heaps. Some households, seeing their cats ill, destroyed them. Though there were no known cases of diphtheria occurring in the practice of the veterinary surgeons at Enfield, yet they saw many cases of 'influenza' at this time among animals. The following is an illustration of the possible connection between diphtheria in children and in cats: A little boy was taken ill with what turned out ultimately to be fatal diphtheria. On the first day of his illness, the cat, which was in the room at the time, licked the vomit on the floor. In a few days (the child meanwhile having died) the animal was noticed to be ill, and, her sufferings being so severe, and so similar to those of the dead boy, the owner destroyed her. During the early part of its illness, this cat had been let out nights in the back yard, as usual. A few days later the cat of a neighbor, who lived a few doors farther off, was noticed to be ill. It had also been out in the back yards at night. The second animal, which, however, recovered, was the pet and playfellow of four little girls, who, grieved at the illness of their favorite, nursed it with great care. All four girls developed diphtheria, the mother being convinced that they got it from the cat; and, indeed, no other known source of contact with infection could be discovered. It is easy to imagine cats catching infectious diseases like diphtheria, when we remember how often milk and other unused food from the sick-room is given to the cat, or by some people thrown out in the back yard for the benefit of their neighbors' cats if they have none of their own. It is a frequent occurrence to see children carrying cats in their arms, and even kissing them. It is obvious, that, if the cats were ill with diphtheria, the children, under such circumstances, would almost inevitably contract the disease.

ELECTRICAL SCIENCE.

Execution by Electricity.

IN view of the new law of the State of New York, doing away with hanging, and the substitution of electricity as the means of execution, a committee was appointed by the Medico-Legal Society to consider the best method of carrying the law into effect. The committee consisted of Dr. Frederick Peterson, Dr. J. Mount Bleyet, R. Ogden Doremus, and Dr. Frank H. Ingram. The committee submitted its report on the 14th inst.

The committee first mentions the experiments made by the commission appointed by the governor to examine into the various methods of causing death. These experiments consisted in placing dogs in a zinc-lined box, partly filled with water, one pole of the dynamo being the coating of the box, the other being a wire wound around the dog's nose or inserted in his mouth. Death was certain and instantaneous, but no data were obtained as to the potentials or currents used. During the summer, experiments were carried out at the Edison laboratory on a number of dogs; and it was shown that an alternating current of 160 volts was sufficient to kill a dog, and that with a continuous current a much higher voltage was necessary. The report proceeds as follows: —

"The average resistance of the human body is about 2,500 ohms. The most of this resistance is in the skin. It is evident, therefore, that the larger the surface of the electrode applied to the body, the greater will be the resistance. It is also a fact that the density of the current depends upon the superficial area of the electrode. A pole of small diameter will hence meet with less resistance, the passing current will be more intense, and the resulting current strength will be greater, than when an electrode of large sectional area is employed."

These statements are not correct; but, before referring to them further, we will summarize the rest of the report. The committee goes on to state that "there can be no doubt that one electrode should be in contact with the head," and recommends that the other be placed in the neighborhood of the spine. To practically carry this out, it proposes that a helmet, containing one electrode, be fitted on the head of the criminal, and he be bound to a table or in a chair, the other electrode fitted so it will impinge on the spine between the shoulders. "The electrodes should be of metal, not over an inch in diameter, somewhat ovoidal in shape, and covered with a thick layer of sponge or chamois-skin. The poles, and the skin and hair at the points of contact, should be thoroughly wetted with warm water. The hair should be cut short." An electromotive force of not less than 3,000 volts should be used, preferably alternating.

In criticism of this report, it should be remarked, in the first place, that the statement, that, because the greatest resistance of the human body is in the skin, "the larger the surface of the electrode applied to the body, the greater the resistance," is directly opposed to fact. The larger the electrode, the *smaller* will be the resistance, and this fact would point to a comparatively large electrode being used.

Again: it is not evident that one of the poles should be applied to the head. It is probable that very little of the current would penetrate the skull and pass through the brain, and that the greater part would pass through the tissues between the skin and the bone. It is probable that a current passing from one arm to another, traversing the vicinity of the heart, would be much more certain in its action than by the plan proposed, with the additional advantage that it is very easy to make contact with the arms. In almost, if not all, the fatal accidents that have occurred, the current has passed in this manner; and by insuring good contacts, and employing 3,000 volts, the results would be reasonably certain. As for the current through the head, we have no data as to the effects produced.

Finally, if the criminal is to be executed according to the plan proposed, the electrodes should be moistened with acidulated or salt water, not simply warm water. The only good feature of the report is in the potential recommended. An alternating current of 3,000 volts would in all probability kill the criminal, however it happened to be introduced.

A SNOW-STORM ON AN ELECTRIC ROAD. — On Friday, Nov. 9, St. Joseph, Mo., was visited by one of the most severe snow-storms in the history of the city. According to the *Daily Gazette*, "the big storm completely paralyzed business, and shut this section of the country off from communication with the world. The snow which fell was of the damp variety, and at 2 o'clock in the afternoon the loaded telegraph and telephone wires began to break under the pressure. Then the heavy electric-light wires began to fall, and at 4 P.M. every thing was demoralized. Many telephones were burnt out, and the entire system of the city was rendered practically useless." Speaking of the cars on the Sprague Electric Street-Railroad, the *Gazette* continues, "There were present all the conditions which it was feared might impair the usefulness of the new motor, but not the least inconvenience or delay resulted. With the use of two-fifths the capacity of the plant, the usual number of cars were operated, and made the usual time. And not only did the storm illustrate the reliability of the electric motor, it also showed that the Union Passenger Railroad line people made no mistakes and did no poor work in constructing their line. Not a wire was broken down, nor was any other defect in the appliances developed. Telegraph-wires were down in every direction, and the telephone-wires of the city suffered great damage; but the wires on the Union Railway line stood the test without the slightest damage."

PROTECTING IRON AND STEEL BY ELECTROLYSIS. — The methods at present in use for the prevention of oxidation of steel and iron have all the same object, namely, the formation of a coating of magnetic oxide of iron; but all of them are more or less unsatisfactory. Considerable time is usually required, and there is no certainty that the protection will be perfect. M. de Méritens has been experimenting for some time on an electrolytic method of obtaining the same result, and has finally been successful. *Industries* describes the process as follows: "The article is exposed to a current of electricity in a bath consisting of ordinary water, or, better, of distilled water, heated to 70° or 80° C. The object to be coated is made the anode, while a strip of carbon, copper, or iron serves for the cathode; or, if an iron tank is used, the sides of the tank may form the cathode. The current should only have an electro-motive force slightly in excess of that required to decompose water, as too strong a current produces a pulverulent form of the oxide, which does not properly adhere; moreover, it has the inconvenience of eating into polished surfaces. The operation should be conducted in the same manner as electrotyping. In the course of a few minutes, black coloration appears on the article, and after one or two hours the coating of magnetic oxide of iron is of sufficient solidity to resist polishing. The coating is found to penetrate into the mass of the metal; for if the external portion be removed by means of emery, and the white under surface be again exposed in the bath, it becomes black again almost immediately, demonstrating that the effect of the first electrolyzing has affected the mass to some depth. When a piece of rusty iron is treated by the current in a warm-water bath in the manner described, the rust, consisting of ferric oxide, is completely converted into magnetic oxide. The exterior layers are not adhesive, but the interior coating is almost as hard as the metal itself. The best processes employed hitherto for coating steel goods require at least eight or ten days, and only imperfect results are obtained when applied to wrought or cast iron. De Méritens's process treats all sorts of iron and steel effectually in a few hours, requires no preliminary preparation, and can be applied as easily to rough as to polished surfaces. The coating is a brilliant black, is very hard, and it is difficult to attack it with lime; moreover, it is not easily wetted by water.

BOOK-REVIEWS.

On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects. (The International Scientific Series, No. LXIV.) By Sir JOHN LUBBOCK. New York, Appleton. 8°.

SIR JOHN LUBBOCK'S varied, valuable, and interesting contributions to science have gained for him a high place among anthropologists and biologists as well as scientists in general. He is an eminent example of the union of ingenuity with painstaking compilation and wide observation that has distinguished so many

Englishmen of science; notably, Darwin, Francis Galton, E. B. Tylor, G. J. Romanes, and others. This reputation is sufficient to secure for any production of his pen wide and careful attention, and to make a notice of its contents a serviceable task. The present volume has more about it of the spirit of the compiler of scientific memoirs than of the ingenious experimenter and the popular writer. A very large share of the work is given over to an anatomical description of the sense-organs of the lower forms of life, and to a discussion of their probable mode of functioning. A bibliographical reference-list of 215 numbers shows how diligently the details have been compiled; and yet the general impression with which one comes away from this portion of the work is, that, in spite of all the work and study, our information is extremely vague and defective. Strange as it may seem, in studying the lower forms of sense-organs it becomes difficult to distinguish between an eye and an ear, an organ of taste, smell, and touch. Our own experience with sense-organs so entirely disposes us to think of the sensations of other animals as essentially similar to our own, that it is difficult for us to realize how different they may be. Not alone are there "animals which have eyes on their backs, ears in their legs, and sing through their sides," but the very sensations thus denoted may really be quite other than in ourselves. Between the highest vibration that we can hear as sound and the lowest that we can see as color, there is an immense gap, which may be only partially present to the senses of other animals.

It would be impossible to indicate here the contents of the richly illustrated descriptions of sense-organs, the enormous variety of their nature and development, their peculiar adaptations to the requirements of the environment. Nature has more than one solution for many of her problems; and the different forms of sense-organs form her answers to the problem of adaptation of physiology to physics. The eye, especially, seems to be a very cheap product; the re-action to light being well established in plants, and the forms of optic organs obtaining an enormously complicated variety in insects. Anatomists have discovered much, but physiologists have done little to give meaning to these discoveries. The method promising best results is the comparison of normal individuals with individuals deprived of a presumable sense-organ. Forel, for example, finds, that, while normal ants will always avoid ultra-violet rays, ants with their eyes varnished are no longer able to distinguish between this and other colors.

Following the chapters upon the anatomy of sense-organs and a chapter upon 'Problematical Organs of Sense,' come chapters upon 'Bees and Colors,' upon 'The Limits of Vision in Animals,' upon 'Recognition among Ants,' upon 'The Instincts of Solitary Wasps and Bees,' upon 'The Supposed Sense of Direction,' and upon 'The Intelligence of the Dog.' Much of the matter here treated has already been published in other shape. It is a *résumé* of points upon which experiments have been made rather than a systematic compilation. The accurate distinction of colors by bees, the connection of this color-sense with the fertilization of flowers, are quite familiar. The limits of vision in animals is a point still deeply in dispute. In answer to the question whether the thousands of ants in one nest, always recognizing one of their own number, but remorselessly attacking all strangers, do so by a smell peculiar to the community, or by a password, the observations seem to say that neither explanation gives complete satisfaction, but further experimentation may clear up its mysteries. The peculiar instincts of wasps and bees, now paralyzing an enemy with all the skill that knowledge of its anatomy could give, again providing for the nutrition of its offspring with a foresight apparently mathematical in its exactness, make us marvel and reflect. Nor is our contemplation made clearer when we observe that this same wise bee has not sense enough to fill up a hole made in her honey-cell, but for an entire afternoon, and more, pours in honey at the top, only to have it flow out of the bottom like the vessel of the Danaides. The wonderful sense of direction ascribed to insects proves, upon careful inquiry, to resolve itself into a moderately successful but by no means infallible or direct appreciation of environment. The final topic, the intelligence of the dog, deserves a further word. In it Sir John describes his attempts at teaching his dog, Van, to express his wishes by language. A large number of cards are printed with such words as 'food,' 'tea,' 'water,' 'bone,' 'out,' and so on, upon them; and by a system of rewards Van has learned to associate his desires with the visual shapes of the letters. When he wants water, he brings not only at command, but spontaneously, the placard bearing that word. This certainly is a noble achievement, and opens up vast possibilities. Quite discouraging, on the other hand, are the attempts to teach the dog to bring a colored card to match the color presented to him. This was diligently taught him again and again, but Van seemed never to get a clear notion of what was desired. 'Can Animals Count?' is the last point treated in the volume, and the question largely resolves itself into determining how large a number of objects can be and the withdrawal of one be noticed. Many animals (birds, etc.) can doubtlessly distinguish between four and five, but no more definite statement can be hazarded. A curious observation is that given by Mr. Huggins concerning his dog, which can apparently perform wonderful mathematical calculations by watching the expressions (all unconscious) of his master, — a valuable hint for telepathy.

All in all, then, the present volume is a convenient and well-compiled reference-book on animal psychology, but is destined to be superseded, as our knowledge advances, by one with fewer gaps and fewer confessions of ignorance. It treats of a fertile field the true importance of which has only recently begun to be realized. A rich success awaits him who has the ingenuity to devise, and the patience to carry out, real successful methods for testing the mental powers of the mute creation; who can decipher these animal hieroglyphics, or force the unwilling sphinx to yield up its enigma.

Works of Thomas Hill Green. Vol. III. *Miscellanies and Memoir.* Ed. by R. L. NETTLESHIP. New York, Longmans, Green, & Co. 8°.

THIS is the concluding volume of Green's works, and consists of essays on a variety of topics, with a sketch of his life by the editor. The memoir is well written, and, for philosophical readers, interesting, though the life of such a man is necessarily lacking in the outward incident characteristic of a more stirring career. The editor, therefore, takes occasion to give an account of Green's views on philosophical and practical subjects, and to indicate to a certain extent the sources in his own character and in the writings of others from which they were derived. Green, as is well known, was an Hegelian; and, though he did not accept all of Hegel's views, the familiar catchwords of the Hegelian philosophy perpetually recur in his writings. The present volume, however, is not all, nor even mainly, devoted to philosophical themes, but contains papers, and some of considerable value, on history, education, and other subjects in which the author was interested. The principal philosophical paper is on 'Popular Philosophy in its Relation to Life,' and is a vehement attack on the English school of thought, especially as represented by Hume. It shows an irritability that is to be regretted, and probably most readers will think the author's own views quite as far from the truth as those that he criticises; but, as illustrating a certain phase of current philosophical thought, the paper is of interest. Several of these 'Miscellanies' are on religious themes, and show the attempts that Green made to adapt the Christian dogmas to his own philosophy, — attempts, as it seems to us, but very slightly successful. For instance: his theory of God is one that makes him no God at all in the view of Christianity or of any other existing religion. He expressly says that God is nothing but the ideal self, the possible perfect man that each of us ought to become; and there is no reconciling this doctrine with the teachings of Christianity.

But, however peculiar may have been his religious views, his interest in moral improvement, both personal and social, was deep and strong. Some of the most interesting passages in the volume before us are those in which he shows his sympathy for the poor, and his desire for their moral and intellectual elevation. He was dissatisfied with existing English society, consisting of the educated few and the uneducated many, and he warmly advocated the extension and improvement of the common-school system as the only practicable means of removing the evils he deprecated. He regarded common education as "the true social leveller," and looked for the time when "the sort of education which alone makes the gentleman in any true sense will be within the reach of all." Besides papers on the various subjects above alluded to, this volume contains a series of lectures on the English Revolution of the seven-

teenth century, in which the causes of that event and of the ultimate failure of the Commonwealth are stated with clearness and true historical insight. Indeed, we think most of his readers will agree that he would have done better to have spent more of his time on history and politics, and less on the inculcation of the Hegelian philosophy.

Ancient Rome. By RODOLFO LANCIANI. Boston and New York, Houghton, Mifflin, & Co. 8°. $6.

THE comprehensive description of the results of modern archæological researches in Rome by Professor Lanciani in the beautifully printed and illustrated volume under review is a publication of great interest and value. The author, who is director of excavations for the Italian Government and the municipality of Rome, describes the results of his labors with such vividness and enthusiasm, that he at once imparts to the reader the keenest interest in his subject. In the preface the history of the work that is going on now is sketched. The improvements undertaken in modern Rome, which of course cannot but necessitate the destruction of a few monuments, have been the subject of numerous attacks upon the Roman authorities, which the author refutes one by one, showing that the growth of the large city, and the requirements of the present inhabitants, made sanitary improvements imperative, and that these very improvements have been made in judicious consideration of the interests of archæology, and that they have yielded archæological results of greater importance than were obtained in any previous period. In the first chapter the history of the destruction of ancient and mediæval monuments is traced, illustrated by views of parts of Rome reproduced from old descriptions.

In the second chapter we are led back to the time of the foundation of Rome, which the author proves to have taken place in the bronze period, by shepherds from the Albanese hills. The remains of stone implements, bronze weapons and coins, and rough earthenware, are described. The development of sanitary measures, the building of the aqueduct and drains, is next described, and the author's views are substantiated by the descriptions of the ruined works and by translations of interesting inscriptions.

We cannot follow the author in the details of his great work, which gives a vivid picture of life in ancient Rome in the light of the most recent archæological discoveries. He has selected only the most significant and valuable material from among the rich treasures intrusted to his care, for proving his views and theories. The publishers have spared no expense in order to make the volume as valuable and attractive as possible. The work cannot be excelled as a comprehensive and popular review of the results of archæological studies in Rome.

B. C. 1887. A Ramble in British Columbia. By J. A. LEES and W. J. CLUTTERBUCK. London and New York, Longmans, Green, & Co. 12°. $2.25.

IN the present volume the authors describe a hunting-trip from the Canadian to the Northern Pacific, up the Columbia and down the Kootenay Rivers. The book is beautifully printed, and illustrated by excellent photo-engravings reproduced from sketches and photographs of the authors. Those who are interested in angling, hunting, and other sport, and in *menus* of the dinners the travellers enjoyed on various parts of their journey, will find the book very interesting reading; but the illustrations make it valuable also to other readers. The authors succeeded in encountering the most marvellous adventures, particularly when they reached American soil, all of which are illustrative of the low state of culture in which our western Territories, as compared to British Columbia, are. If we take the authors' description *cum grano salis*, it is a good description of what travelling in the Kootenay valley under unfavorable circumstances might be. The good luck of the authors in having many marvellous adventures makes the book very interesting reading, and welcome to lovers of books of travel.

Die Gletscher der Ostalpen. By Dr. E. RICHTER. Stuttgart, J. Engelhorn. 8°. $3.

THE present volume belongs to the series of manuals of German geography published at the instance and under the direction of the commission for studies on the geography of Germany, which also edits the interesting 'Forschungen zur Deutschen Landes- und Volkskunde.' Dr. Richter has compiled a large amount of material on the glaciers of the eastern Alps, his material being principally derived from the map of the Austrian War Department. In an introduction the author discusses the methods of determining the limit of eternal snow, and adopts the principle first applied by Brückner, who collates data on summits which nearly reach the limit of eternal snow, but have no accumulations of snow and ice on exposed slopes, and such data on mountains which have small snow-fields and glaciers. He concludes that the snow-line is intermediate between the heights of the summits of these mountains. Dr. Richter discusses this method very fully, and later on applies it to the eastern Alps. We cannot enter into his interesting descriptions of glaciers and of their advance and retrogression, but call attention to an important result of his investigations, that the central parts of the Alps have a higher level snow-line than the northern and southern portions. Chains of mountains have the same effect upon the height of the snow-line as plateaus have, the line being lower on the outskirts and higher in the central portions.

NOTES AND NEWS.

IN a memorandum prepared by the executive committee of the Dominion Land Surveyors' Association a number of rules are suggested as a remedy in the confusion of the geographical nomenclature and orthography in Canada. The principal feature of these resolutions is the suggestion of the compilation of a complete geographical dictionary of the Dominion by the Department of the Interior, and that all names given by explorers in new tracts of country be submitted to the surveyor-general, and, after approval by him, be entered in the geographical dictionary before being shown on any official maps or plans. Besides this, the rules of the Royal Geographical Society for spelling Indian names are recommended.

— The *Flamme*, the official organ of the Berlin Cremation Society, states that the total number of bodies cremated in the various countries to the 1st of August is as follows: Italy, 998; Gotha, 554; America, 287; Sweden, 39; England, 16; France, 7; Denmark, 1. The members of cremation societies number 3,012 in Sweden, 1,326 in Denmark, 1,326 in Holland, 612 in Germany, 580 in Italy, 438 in Hamburg, and 390 in Switzerland (Zurich). There is a curious disparity between the number of members in Italy and the proportion cremated. It is officially stated that outside of Asia there are but fifty cremation-furnaces in existence. Of these, twenty are in Italy, one in Germany, one in England, one in Switzerland, one in France, and the rest in the United States. From this statement it would appear that cremation has not made the rapid strides which its advocates hoped for.

— Mr. A. Howard Clark, of the Smithsonian Institution, has been appointed by the President to be one of the scientific experts to attend the international exposition in Paris in 1889. Mr. Howard was a member of the executive staff of the United States commissioner to the international fisheries exhibition in London, in 1883.

— Prof. C. V. Riley, of the Agricultural Department, the representative in charge of the exhibit of agricultural products from this country to the Paris exposition, has issued a circular in which he announces that a board has been formed in the Department of Agriculture, consisting of Professor Riley, William Saunders, O. D. LaDow, M. Trimble, and Dr. D. E. Salmon, to decide upon the agricultural exhibit.

— No. 95 of Van Nostrand's Science Series is entitled 'Plate-Girder Construction,' by Isami Hiroi. For railway as well as highway bridges, there is probably no other form of girders that are more extensively used and daily being constructed than plate-girders. The reason for this lies mainly in the simplicity of their construction, and their stiffness as compared with open-girders. That the construction of a plate-girder is simple, is, however, no reason to suppose that the stresses produced in it by external forces are also simple. On the contrary, to determine actual stresses in every part of a plate-girder is one of the most complicated problems that can

come in the way of bridge engineers. It is the aim of the writer to present, in as simple a manner as possible, a somewhat rational mode of designing girders of this class with special reference to American practice; and, in the absence of any particular treatise on the subject within the reach of every one as yet, it is hoped that it may be of some help to beginners in bridge-designing. —— Some questions addressed to the editor of *The Engineering and Building Record and The Sanitary Engineer* by persons in the employ of new water-works indicated that a short series of practical articles on the details of constructing a water-works plant would be of value; and at the suggestion of the editor, Mr. William R. Billings prepared a series of papers for the columns of that journal, entitled 'Some Details of Water-Works Construction;' and now, in a more convenient form than is afforded by the columns of the paper, these notes of actual experience are offered to the water-works fraternity with the belief that they may be of assistance to beginners, and of some interest to all. —— The Popular Publishing Company at Chicago Lawn publishes a 'Key to the Families of Insects,' by N. M. Eberhart, which gives in a few pages the characteristic features of each order and family of insects. —— Prof. John Henry Comstock has published the first part of an 'Introduction in Entomology.' The work has been prepared to meet the demand for a text-book which shall enable students to acquire a thorough knowledge of the elementary principles of entomology. Although much pains has been taken to render easy the classification of specimens, an effort has been made to give the mere determination of the names of insects a very subordinate place, much space having been given to the habits and transformations of the forms described. The book is illustrated with many figures, many of which are originals. It will prove of good use to students of entomology. ——The Clarendon Press has published the first volume of Robert Etheridge's great catalogue, 'Fossils of the British Islands,' comprising the paleozoic species. The preparation of the manuscript of this catalogue was begun in 1865, and since that time the author has continued this work. The present volume comprises 1,588 genera and 6,022 species arranged stratigraphically, and also classified zoölogically. A supplementary index brings the work down to 1886. It not only contains all additional species described since the catalogue was in type, but also records the changes in the nomenclature and distribution of many zoölogical groups and species previously catalogued, which had been rendered necessary by the progress of research. —— Mr. William Archer, the English dramatic critic, has just completed 'Masks or Faces?' a study in the psychology of acting, which Longmans, Green, & Co. will issue at once. Mr. Archer takes up afresh the question debated by M. Coquelin and Mr. Irving as to the amount of feeling an actor should have. He has collected from books and from leading living actors a mass of pertinent and interesting anecdotes. Among those who have helped him are Mary Anderson, Mrs. Kendal, Genevieve Ward, John Drew, and Dion Boucicault. The same firm will bring out '[Son of a Star,' by Dr. B. W. Richardson. This is an historical romance of Great Britain and Judea in the days of Hadrian. —— Ginn & Co. will publish in January, 1889, 'The Leading Facts of French History,' by D. H. Montgomery. The general plan of treatment is practically the same as that pursued in the author's 'Leading Facts of English History.' —— Scribner & Welford announce 'The Reminiscences and Recollections of Captain Gronow: being Anecdotes of the Camp, Court, Clubs, and Society, 1810–1860,' with portrait, 4 woodcuts, and 20 etched and aquatint illustrations from contemporary sources, by Joseph Grego. It had been the lot of Captain Gronow "to have lived through the greater part of one of the most eventful centuries of England's history; to be thrown amongst most of the remarkable men of his day, whether soldiers, statesmen, men of letters, theatrical people, or those whose birth and fortune — rather, perhaps, than their virtues and talents — have caused them to be conspicuous at home and abroad." The twenty plates etched by Joseph Grego throughout, are finished in aquatint, — an art which flourished at the period in question, and was much in favor for book-illustration. Mr. Grego has been fortunate in securing the assistance of an artist who for more than half a century has devoted himself to the development of this branch of art. The edition consists of 870 copies for England and America, with the 25 illustrations in duplicate, — one on plate paper, remarque proofs; and the other on Whatman paper, with titles, and colored by hand. The type has been distributed. Each copy is numbered as issued. —— 'Worthington's Annual' is the handsomest juvenile book made this year. It is a surprise for the price ($1.50) in the quality and quantity of matter and engravings. It has an illuminated cover, brilliant full-page colored plates made expressly for the book. It is something more than a mass of pretty pictures. It has interesting stories, biographies, papers on natural history, and these are illustrated by more than 300 engravings. No expense or pains have been spared to make it worthy of the wide constituency which it is bound to have. It is in every way creditable to author and publisher, and will be hailed with delight by armies of children. If any better or larger children's annual, or one more entertaining and instructive, was ever made for the price, we have yet to see it. It is a striking proof that publishers sometimes look to the interest of their readers as well as to their own profits. We commend it heartily.

— 'Dunraven Ranch' is the name of the new novel which Captain King contributes to the December number of *Lippincott's Magazine*. A full-page portrait of the author decorates the number. A biographical sketch by Lieut. Philip Reade, who has been King's lifelong friend, gives many episodes in the life of the soldier-author. The serial 'At Last: Six Days in the Life of an Ex-Teacher,' by John Habberton, is of interest. 'With the Fruits and the Wines,' by G. S. R., is a sketch full of information. Thomas Leaming has a valuable article on 'Trust and Title Insurance Companies,' in which the growth and development, the uses and possible abuses, of these novel institutions, are treated. The One Hundred Prize Questions are as interesting as ever. Of the poetry, the most notable is Edgar Saltus's 'Imeros' and a series of sonnets by Amélie Rives, 'To all Women.' —— In *St. Nicholas* for December is Mrs. Mabel Loomis Todd's account of a stay of 'Ten Weeks in Japan,' in which the story of the total eclipse of August, 1887, is told from the experience of an actual participant in the observations. The instruments and the temporary encampment of the expedition, as well as many beautiful and strange sights of this interesting country, are presented to the reader by illustrations taken from photographs. —— In the *Atlantic Monthly* for December are to be 'The Future of the Country College,' by William De Witt Hyde; 'Passe Rose,' X.–XII., by Arthur Sherburne Hardy; 'Urbs Animæ,' by H. W. P. and L. D.; 'A Devil's Passage,' by Louise Stockton; 'The Close of Garibaldi's Career,' by William R. Thayer; 'A Flight in the Dark,' by S. K. and V. D. S.; 'Boston Painters and Paintings,' by V. William Howe Downes; 'William Warren,' by Henry A. Clapp; 'A Convent School of the Last Century,' by Susan Coolidge; 'The Despot of Broomsedge Cove,' XXV.–XXVI., by Charles Egbert Craddock; 'At Alfred de Musset's Grave;' 'Letters from Dorothy Osborne to Sir William Temple;' etc. We observe, by the way, that the publishers are to furnish in the January number a new steel engraving of John G. Whittier, who wrote one of the articles which appeared in the initial *Atlantic* for November, 1857, and who has been a frequent contributor from that time to the present. —— *The Classical Review*, established less than two years ago, has already amply justified the hopes of its founders. Under the editorship of the Rev. Joseph B. Mayor, assisted by Prof. A. J. Church, Mr. A. M. Cook, and Mr. Cecil Smith, it has secured the active support of the leading classical scholars of Great Britain. The familiar names of Archer-Hind, Butcher, Ellis, Hicks, Henry Jackson, Jebb, Lang, Leaf, J. E. B. Mayor, Merry, Monro, Nettleship, Newman, Palmer, Reid, Roberts, Sandys, Sidgwick, and many others, are found in the list of contributors. The English editors of the *Review* desire to make it an international philological organ, and have invited Prof. Thomas D. Seymour of Yale College, Prof. John H. Wright of Harvard University, and Prof. W. G. Hale of Cornell University, to act as associate editors for the United States. They propose to increase the size of the *Review* by one-half, giving three sheets (forty-eight pages) to each number, and thus allowing ample space for contributions from American scholars. The invitation has been accepted, and the proposed arrangement will go into effect with the first number of Vol. III. (January, 1889). Ginn & Co. are the publishers for America.

Publications received at Editor's Office, Nov. 5-17.

COX, P. Queer People with Paws and Claws and their Kweer Kapers. Philadelphia, Hubbard.
EVANS, G. A. Hand-Book of Historical and Geographical Phthisiology. New York, Appleton. 295 p. 12°. $2.
FINLEY, J. P. The Tornadoes of Iowa for 51 years, 1837-1887. Washington, J. H. Soulé. 16°.
——Tornadoes, What they are, and How to Escape them. Washington, J. H. Soulé. 90 p. 16°. 25 cents.
GREEN, Thomas Hill, Works of. Ed. by R. L. Nettleship. Vol. III. Miscellanies and Memoir. London and New York, Longmans, Green, & Co. 479 p. 8°.
HIMMEL und Erde. Ed. by Dr. M. W. Meyer. Vol. I. No. 1. Berlin, Hermann Paetel. 68 p. 8°.
LEES, J. A., and Clutterbuck, W. J. B.C. 1887. A Ramble in British Columbia. London and New York. Longmans, Green, & Co. 387 p. 12°. $2.25.
LUBBOCK, J. On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects. New York, Appleton. 292 p. 12°. $1.75.
PENNSYLVANIA State College, Report of the, for the Year 1887. Part II. Agricultural Experiment Station. Harrisburg, State 226 p. 8°.
RICHTER, E. Die Gletscher der Ostalpen. Stuttgart, Engelhorn. 306 p. 8°.
SUMNER, H. The Besom Maker and other Country Folk Songs. London and New York, Longmans, Green, & Co. 27 p. 12°. $1.
TUNISON, J. S. Master Virgil. Cincinnati, Robert Clarke & Co. 230 p. 8°. $2.

SCIENCE

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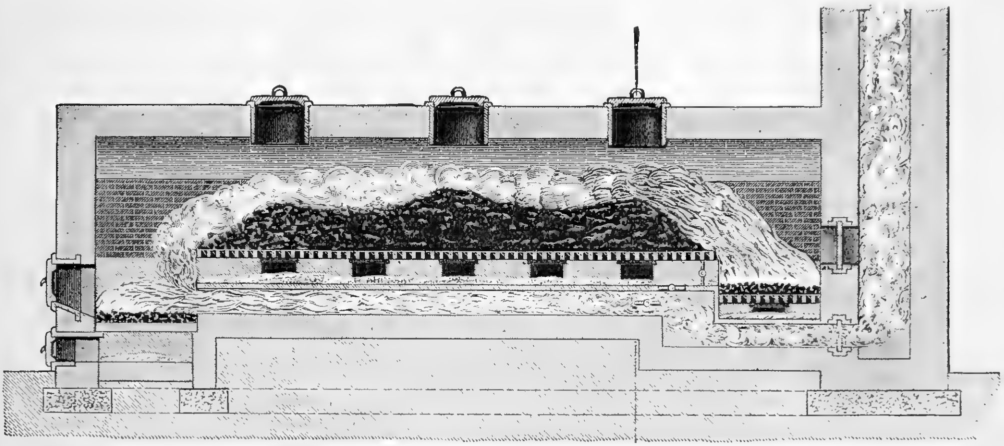
FRIDAY, DECEMBER 7, 1888.

GARBAGE-CREMATION.

IF we may judge from the discussions of the American Public Health Association for the past two years at its annual meetings, the most important practical sanitary problem of the time is how to dispose of the garbage and night-soil of populous communities. For cities situated on the seaboard this question is not such a pressing one, as the refuse can be transported by water sufficiently far from the shore, and deposited in the ocean. If it returns on the incoming tide, and is cast on the beach, this may in the future be avoided by carrying it still farther. But to inland towns and cities no such method is available. For years many of these have cast heir waste into the river, if such ran near them, or to a general dumping-place near by, and were content to know that they at least were relieved of the burden, caring little that their sister cities, situated farther down the river, were injuriously affected. Not until a direct detriment either to a city's health or financial prosperity can be traced to such methods, is there a disposition to invoke the aid of sanitary science and the ingenuity of the inventor. The rapid growth of interior towns in the United States has made some radical method of the disposition of such material an absolute necessity, and, by the common consent of all sanitarians, no method offers such advantages as its destruction by cremation.

Of the many devices which have been invented for the conversion of noxious waste into a harmless residue through the instrumentality of fire, none seems to have more effectually accomplished the object than the Engle cremator. The principle involved in the invention resides in the use of two fires at the opposite ends or sides of the garbage or other substances to be burned; and in managing the fires so that one of them operates to volatilize the liquid constituents of the substances, while the other operates to burn the steam and other gases which arise from the volatilization; and then in so managing the fires as to complete the process of burning the dry residuum, or reducing it to a fertilizer, if so desired. The economy of the process, aside from the simplicity and low cost of the furnaces, lies in the fact that comparatively little coal or other fuel is required to start the two fires. The gases and other products from the substances being cremated complete the process of burning, the substance thus in great part supplying the fuel for its own destruction.

The following description and cut of the garbage-furnace which was erected at Des Moines, Io., will make clear the method by which Mr. Engle adapts this principle to practice. The cut presents a vertical longitudinal section of the furnace, showing its forward end toward the left. The upper door shown in the left-hand end opens into the fireplace, and the door immediately below opens into the ash-pit thereunder. The five larger openings shown on the side of the furnace midway of its length open into the ash-pit under the grate, which supports the garbage and other wet and offensive substances which are being burned. Five smaller doors above open into the garbage fireplace in order to give easy access thereto, in case it becomes expedient to stir or otherwise move the garbage in the fireplace while it is being consumed. There are also openings into the rear fireplace, and into the pit under it. Three angular valve-handles operate the three valves which appear in the figure to the left of the rear fireplace. The two valves which appear in the figure give egress into the chimney from the first fireplace and the second fireplace respectively. The three covers on the top of the furnace close the downward openings in the top of the furnace, through which the matter may be dumped upon the grate.



VERTICAL LONGITUDINAL SECTION OF THE DES MOINES GARBAGE-FURNACE.

The mode of operation is as follows: The garbage and matter to be consumed are dumped upon the garbage-grate, and a fire of coal is made in each of the two fireplaces at the respective ends of the furnace. The flames from the rear fireplace pass over the garbage, driving before them the steam and other gases arising therefrom into the flames above the forward fireplace, where the flames from the two furnaces meet and mingle. As those mingled flames pass backward toward the chimney, they intensely heat the iron floor of the garbage ash-pit, and that floor conducts heat upward toward the garbage above it, and thus aids in volatilizing the liquid constituents thereof. This operation continues until the substances on the garbage-grate are reduced to a dried condition, when the lower chimney-valve may be closed and the upper chimney-valve opened; and thereupon the flames will pass from the forward fireplace above the garbage-grate, and ignite the dried sub-

stances resting thereon, and drive the products of the resulting combustion into and through the flames above the rear fireplace.

Health Officer Thompson of Chicago visited Des Moines to inspect the working of the garbage-crematory there, and in his report says, "The cost of the operation is much less than at the Montreal furnace. The device is simple, but it is as effective as any I know of. It does not need skilled labor, and does not use much coal. Two men seemed to be able to do the work there that ten did in Montreal. This furnace was built by Mr. James Callanan, a wealthy Des Moines citizen, to demonstrate what could be done in the way of disposing of garbage quickly and completely without offensive smell, and it is attracting attention all over the country. . . . I think myself that the Des Moines one is the best, and it is much the cheapest, and I am in favor of putting up our first one upon that plan." He further says there were thrown into the furnace while he watched it two dead horses, seven dogs, eighteen barrels of garbage, three hods of manure, fifteen bushels of rotten eggs, and three barrels of rotten fish. This was all consumed in one hour, with no offensive smell from the combustion, and no smoke. The furnace was cold when started.

The Des Moines *Leader* thus speaks of the Engle cremator: "The especial advantage of this apparatus is that it may be located in any part of the city without any offence. It is the invention of Andrew Engle of Baxter, Io., who also invented the process of destroying the filth of closets in houses by fire, which process, when once in general use, will avoid the necessity of polluting streams and lakes with deadly sewerage. A furnace built for this purpose has been in use in the old Capitol building at Des Moines for the past three years. It has given complete satisfaction, and demonstrated its adaptability for hotels, public buildings, and private residences."

The Engle Company erected one of their crematories, twenty feet long, in September of this year, at West Brighton, Coney Island, and had it in use until the close of the season, giving such satisfaction to the town authorities as to induce their hearty recommendation of its merits as being economical, scientific in principle, and cleanly and efficient in its methods of disposing of the refuse, and seemed to them the best means for the treatment of such nuisances.

One of these furnaces has just been erected at Milwaukee, Wis., and was put into operation during the recent meeting of the American Public Health Association in that city, and inspected by many of the members.

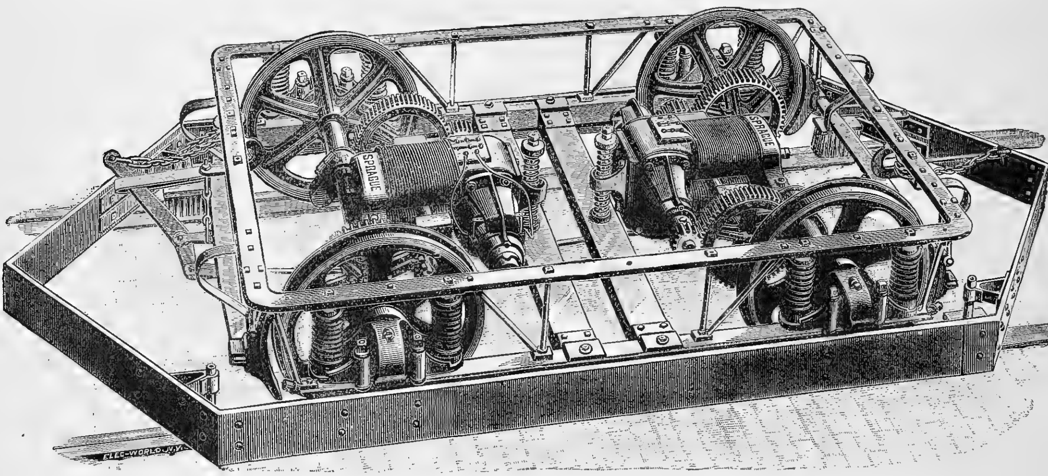
It is claimed for this furnace that it is not only applicable to large cities, but to almost every collection of human beings, even to a single family living in a private dwelling. The inventor says that its use is indicated in private dwellings in any locality in the country or city, but especially in all places where no system of waterworks is in operation, and also in villas and suburban places, where there may be a private water-system, but where drainage is into cesspools or small streams. The great majority of dwellings in the United States have neither water-closets, cesspools, nor drainage, and have none but the most cumbrous and inadequate method of coping with the great evil. The very low cost of the small furnaces brings it within the means of those who occupy the smallest class of houses, and its feasibility has been demonstrated for tenement-houses and for blocks of buildings in towns, as well as for detached houses.

For seaside or mountain resorts, where sanitary measures are more and more demanded by the public, this system affords the means of answering the demand, and will add to the popularity and desirability of such resorts by removing the great dread which city people have of typhoid and malarial poisoning. They can be placed in the basement or cellar, or in outhouses built for the purpose, wherever they can be connected with a chimney for draught and ventilation.

These furnaces are themselves the receptacle or vault, and no disinfectants or absorbents are needed, and no removal or handling. When fired, the valves are closed until the cremating process, lasting about an hour, is over. No skill beyond ordinary intelligence is required for the management of the fire or the apparatus.

For schoolhouses, large or small, it is believed this furnace will remove the greatest menace to the health of the children, and be a long step toward decency and comfort.

For factories or other establishments, and for military barracks; for railroad-stations, for camp-meeting or picnic grounds, and for all other collections of summer-houses; for county court-houses, jails, and other public institutions in city or country; for hospitals and prisons, — this system will be found to have advantages.



NEW SPRAGUE TRUCK FOR STREET-CARS.

THE NEW SPRAGUE ELECTRIC-MOTOR TRUCK.

WE take pleasure in presenting our readers with a view of the new electric-motor truck, constructed by the Sprague Electric Railway and Motor Company of New York. This truck is the same that was exhibited by the Sprague Company at the last street-railway convention at Washington, and one which attracted such wide attention and admiration there.

This truck is complete in every detail, and carries two powerful 15-horse power motors of a new design, and of the finest workmanship. Every detail of mechanical and electrical construction

is carefully attended to, and the most recent improvements which experience could suggest, have been adopted to meet the exigencies of street-car service.

The motors have the regular Sprague mounting, as shown in the illustration, being centred on the axles, and flexibly supported to prevent accident from sudden strain. They are very compact and powerful, and combine the requisites of lightest weight possible with highest efficiency. Without this flexible suspension for both directions of running, it is hard to imagine how a motor can be successfully applied to street-cars and fulfil all conditions of actual experience.

Only one intermediate is used between the armature pinion and the main gear. The gear upon the intermediate, which meshes into the main gear, is built of vulcanized fibre, making it absolutely noiseless, is so constructed that it is very durable, and it will outwear the steel teeth which mesh into it.

All the bearings are self-oiling and completely dust-proof, and should run at least a month with little or no attention, and each is so constructed that it can be removed without dismounting the machine. The brushes are on an entirely new principle and design, and are remarkable for ease of adjustment, and work with equal facility in running either forward or backward. By their means a perfect electrical contact is secured, without excessive pressure on the commutator, and all wear is reduced to a minimum.

The whole motor and the gearing, and all parts, are so placed that they can be perfectly shielded and shut in by a tight-fitting cover, so that by this means it is rendered impossible for moisture or dust to get into any of the working parts.

The design and construction of every part of this truck are not only to have each detail as strong as possible, but also to have it readily accessible, and to reduce all care and attendance to a minimum.

We congratulate the Sprague Company upon the success which has attended their installations in the past, and we anticipate for them an increased success in the future.

SCIENTIFIC NEWS IN WASHINGTON.

How Birds soar: the Conditions of the Atmosphere, and not a Peculiar Structure of the Bird, the Essential Factor. — How Men of All Ages and in Every Country have made of Themselves Beasts of Burden. — How the Navajo gamble.

The Soaring of Birds.

WHOEVER has watched an eagle or other soaring bird as he circles through the air has marvelled that he is able to sustain himself without the flapping of his wings. Not only does he do this, but he rises higher and higher from the earth, enlarging his circles and seemingly increasing his speed, until he attains so great a height as to be almost invisible. This apparent defiance of the laws of gravitation has long been recognized as a problem to be solved, and many explanations have been offered. The latest contribution to the subject is by Mr. G. K. Gilbert, who read a paper to the Philosophical Society of Washington at its last meeting. He concluded by saying that when he proposed to the society's committee to place the paper on its programme, he supposed his theory of soaring to be novel, but that he had since found himself anticipated by Lord Rayleigh, who communicated the same explanation to *Nature* in 1883 (vol. xxvii. p. 534), and by Mr. Hubert Airy, who independently reached the same result at about the same time (*Nature*, vol. xxvii. p. 590). It appeared, however, from the informal discussion which followed the reading of the paper, that the earlier presentation of the theory had escaped the attention of many ornithologists and physicists present, and it may therefore not be amiss to restate it in the pages of *Science*. The following paragraphs are extracted from Mr. Gilbert's paper.

"The soaring bird, with wings expanded, is formed so as to move forward with little friction, and downward with great friction. We may conceive him as having two coincident motions, — a forward motion, initiated by muscular action; and a downward motion, slow but continuous, under the pull of gravity. By variations of the attitude of his wings and tail, he can and does control the direction of his forward motion.

"If the forward component of motion is horizontal, the resultant of the two motions is obliquely downward. In order that the resultant may be horizontal, it is necessary (1) that the forward component be directed obliquely upward, and (2) that it exceed a certain minimum amount.

"However small may be the friction created by the forward motion, it is not *nil*. It constantly tends to check the motion; and, unless the energy it consumes is in some way replaced, the forward motion is eventually so reduced that horizontal motion cannot be maintained.

"It is proposed to show that the needed compensatory energy may be derived from the differential motions of the air.

"I shall not dwell on the utilization of upward currents of air. It is evident without explanation that when a bird sails through air that is rising, whether vertically or obliquely, he is carried upward with the air, and, if the upward motion of the air equals or exceeds the downward motion of the bird under gravity, he does not need to flap his wings in order to sustain himself. But such opportunities are of exceptional occurrence; and, while it is highly probable that they are not neglected, recourse to soaring is too frequent, and with certain species too generally successful, to permit us to believe that an upward current is its necessary condition. I shall confine my attention to the less obvious resource of horizontal currents.

"It is frequently observed that the velocity of the wind increases from the ground upward. Let us assume, for simplicity's sake, that the air-currents above and below a certain horizontal plane have the same direction but different velocities, the upper moving the faster by a certain amount, i. A soaring bird is moving through the lower air in the opposite direction, and the bird's velocity with reference to the air is V.

"It should be borne in mind that velocity is merely rate of relative motion. Fully to define the velocity of a body, it is necessary to state to what other body its motion is referred. In this case the velocity of the upper current with reference to the lower current is i; the velocity of the bird with reference to the lower current is V; and, since the bird and the upper current pass the lower current in opposite directions, the velocity of the bird with reference to the upper current is $V+i$.

"Now let the bird change his course, turning obliquely upward and passing into the upper current. His velocity with reference to the air in which he is immersed is at once increased from V to $V+i$. Next let the bird wheel, to the right or to the left, until the direction of his motion is coincident with that of the wind. His velocity with reference to the upper current is still $V+i$, but the reversal of his direction has changed his relation to the currents. He is passing the lower and slower current more rapidly than he passes the upper, and his velocity with reference to the lower current is greater by their difference: it is $V+2i$. Now let him descend obliquely, and enter the lower current. His velocity is not affected by the transfer. It is still $V+2i$, referred to the lower current. Finally let him wheel in the lower current until his direction is once more directly opposed to that of the wind. The cycle of evolutions leaves him with the velocity $V+2i$, referred to the lower current, in place of his initial velocity V, referred to the same datum. He has gained a velocity $2i$, or double the velocity of one air-current referred to the other, and he has resumed his original relation to the currents. Manifestly he can repeat the process indefinitely.

"Add now that the velocity thus gained is the required compensation for the velocity lost by friction, and the essence of the theory is stated."

Mr. Gilbert then proceeded to pass from the special case assumed for the sake of simplicity to the more general case, pointing out that certain assumptions which facilitated the statement of the theory were not essential to the analysis. Provided the air in the region traversed by the bird has some differential motion in a horizontal sense, and provided the bird regulates his circling course so as to ascend when his direction of flight is opposed to the direction of the differential motion of the air into which he rises, and so as to descend when the relations are reversed, he will acquire from the differential motion of the air an acceleration of his own velocity. If this acceleration is less than the concurrent loss by fric-

tion, he cannot sustain himself by soaring alone; but, if it equals or exceeds that loss, he can sustain himself indefinitely.

After a discussion of various qualifying factors, it was stated that when the orbit of the bird is circular, and lies in an inclined plane rising toward the wind, and when the horizontal velocity of the air diminishes uniformly from the highest point to the lowest point of the orbit, the velocity gained by the bird in making the circuit is equal to the differential velocity of the highest and lowest layers of air traversed, multiplied by $\frac{\pi}{2}$ into the cosine of the angle of inclination of the plane of the orbit.

It was especially insisted that the theory does not propose to make something out of nothing, but appeals to a transformation of existing energy. "The differential motion of air-currents is a true store of solar energy, and the circling of the bird through the two currents enables him to draw on that store. The process is essentially homologous with the utilization of the relative motion of air and ocean for the sailing of a ship, and with the turning of a mill or the flying of a kite by means of the relative motions of air and ground or of air and boy; only in the case of the bird the apparatus is not in continuous contact with both members of the motive couple, but passes to and fro between them. The function of the kite-string is performed by the inertia of the moving bird."

It is evident, that, if this explanation is sufficient, soaring is impossible without differential motions of air, and is therefore impossible when the air has no motion; if it is sufficient, the circling of soaring birds is not merely habitual, but necessary; and if it is sufficient, observation should show that their circles are higher on one side than on the other.

Human Beasts of Burden.

Prof. Otis T. Mason has been many years engaged in the collection of material for a monograph or book upon the subject given above, and now has, systematically arranged, descriptions of several hundred different modes by which human beings, in civilized and savage countries, make themselves the vehicles for the transportation of burdens. Each of these he has had illustrated by a drawing, so that the whole is not only of the highest ethnologic value, but will be exceedingly interesting to the non-scientific reader.

At the last meeting of the Anthropological Society of Washington, Professor Mason read a paper in which he described some of the more common ways in which man has made himself a beast of burden. The brief abstract given here presents some of the more salient parts of the paper.

In his prefatory remarks, Professor Mason explained that this was a subject that had awakened his deepest interest, and that the paper he presented was but an introduction to other researches by means of which he proposed to fully investigate and demonstrate the growth of commerce as carried on through the agency of the human body. That the aboriginal inhabitants performed great feats in the way of transporting materials is shown by the co-existence of raw copper on the shores of Lake Superior, and manufactured copper implements in the remains of the mound and cave dwellings in the southern part of the country. The same thing is true of the presence of wrought jade, which is found in China and in the Swiss lake-dwellings. Men and women were the first beasts of burden, and it is undoubtedly true that all aboriginal carrying was done on their heads and backs.

Even the improved state of civilized society has not extinguished all traces of this, for human carriers are still numerous. Hod-carriers have but recently, and indeed but partially, been superseded by elevating machines. The great progress of the time has been such, continued Professor Mason, that no one walks nowadays unless it is a preferred exercise: horses, steam, and electricity lend their aid to whirl people to their destinations. It is considered vulgar to carry a parcel: the humblest servant-girl, buying a few cents' worth, may have her purchase taken home in a special-delivery wagon covered with forty coats of lacquer. It has been calculated that two million tons are constantly worn by the human race in the way of dress and ornament.

The paper then enumerated the various methods by which the various beasts of burden perform their carrying-tasks; first of all, the hand, — the right hand. In speaking of this, Professor Mason said that he has examined a great number of savage implements designed to be carried in the hand, and that the proportion of those shaped for use by the left hand was not greater than 1 to 50. In no case did he find a left-hand female implement. Then both hands are used, after which the fingers come into play. As an illustration of the use of the fingers in carrying, Professor Mason mentioned the summer-resort waiter, who bears his tray aloft on three fingers. The baldric is next in order, slung over the shoulder by a strap, and hanging on the hip. In this way hunters carry game, and travellers carry small satchels. Then, still progressing, goods to be carried are hung to a belt. Hanging things on the arm may be called the retail method of carrying, and is used by farm-hands, servants, porters; in fact, by a large proportion of the people we meet in any place. While a civilized being will twist his form so as to get the load that is hung on his arm supported by his back, a savage will never be found doing so. Next comes the hanging over the shoulder, of which a good example is the universal sack of the negro vagabond, containing unclaimed property and other people's chickens. This method is used by grain-porters and hod-carriers.

The Oriental porters carry almost exclusively on their shoulders. A cooly's average load is a hundred pounds, with which he can make thirty miles a day. It is estimated that there are a million tons of material moved by coolies in China each day. Then both shoulders come into use, the load being placed round the neck; after which an easy progression is to the back, which is the natural carrying-place of the burden. The soldier, carrying his knapsack and rations, is a good example. Then loads are carried on the heads, — a process called 'toting.' The negro is a domestic example, and dairy-maids are reputed to carry their milk-pails on their heads, and there are many other illustrations of this mode of transportation. Certain tribes of Indians wear straw rings on their heads to aid in bearing and balancing these great loads. Pockets, remarked Professor Mason, are scarcely worth mentioning as a civilized means of transportation, although the flowing robes of a Chinaman are capable of concealing at least half a bushel of playing-cards, — a capacity that deserves passing notice.

The carrying-power given by these various modes is augmented by means of combinations of men, in illustration of which the vast works in Egypt and other Eastern countries were cited. Men also carry goods by traction; that is, by drawing over the ground. First the arm alone is used, then a line is fastened to the object and to the person. It is held in the hand over the shoulder, or wound over the waist or over a pole. The hunter drawing home his game is a primitive example of this means of carrying. Throwing is sometimes resorted to as a mode of transportation, of which the negro method of handling watermelons by tossing them from hand to hand is a fair example. Dirt and excavated material were at first carried in sacks, which have been superseded by shovels. The great necessities and the differentiating processes of civilization for rapid and safe transportation give rise to the professional carriers, among whom may be mentioned carriers, messengers, mail-men, and pedlers. For much of this excellent abstract, *Science* is indebted to the Washington *Evening Star*.

A Queer Game among the Navajo.

'Navajo Gambling Songs' was the title of a paper read by Dr. Washington Matthews at the last meeting of the Anthropological Society of Washington.

The Navajo Indians, he said, have numerous songs, many of which are sung during the progress of a gambling game called 'kesichay' (this spelling, Dr. Matthews afterward explained, will suffice). The game is founded on a myth which forms one of the traditional beliefs of the Navajo. The songs used in this game are almost numberless; and one old man of whom the doctor asked the number, said, with an intended exaggeration, that there were over four thousand in the game. Another said that there was a song for every bird that flies, every animal that crawls or prowls.

The game is sacred, and is usually played in winter, and always in the dark hours. When asked why the night should be selected for the game, one Indian remarked that "he on whom the sun shines while playing the kesichay will be stricken blind." The

game is played in a lodge or wigwam. Six moccasons are buried with their tops even with the ground, in two rows several feet apart, and filled to their edges with sand.

The Indians divide into two parties, and draw lots for the first move. The winners of the move take a small black stone, and, raising a blanket between themselves and their opponents to conceal their operations, hide the stone in one of the moccasons, burying it in the sand so that it is entirely out of sight. The others then try to find the stone by striking with a stick the moccason supposed to contain it. If they find it, they take the stone in turn and hide it, the others guessing; but if they fail, their opponents hold it until it is found, each time hanging up the blanket, and changing, or pretending to change, its location. The game is counted by means of a hundred and two long slender sticks on each side, which change hands as the sides win or lose. The system of counting is very intricate, the count depending upon the location of the ball. Four, six, or ten counters change hands at each hiding. The chances are almost all in favor of the holders of the ball; and frequently one side will lose all of their counters before the ball is found, when the game comes to an end. Two of the counters on each side are notched, and are called 'grandmothers.' When there has been a long run of bad luck, the 'grandmothers' are stuck up in the ground and told to go and seek their grandchildren, meaning to bring back the luck and the lost counters. It is supposed to be lucky to hold the 'grandmothers' until the last: so they are not laid out until the others are all gone.

The myth on which the kesichay is founded is based, like most other Indian traditions, upon the sayings and doings of animals in those ages when the world was supposed to be peopled entirely with beasts. There were some animals, the tradition runs, that saw better, hunted better, and were happier, in the light, and others that liked the dark. As it was thought wise that the existing alternation of night and day should be changed so as to suit one or the other of these classes, it was determined to call a council of the animals to determine in whose favor the change should be made. When all were together, they decided to play the kesichay to settle the controversy. The council was held at night, and the game progressed with varying success for many hours. During the play the animals of either side began to sing songs illustrative of their luck or their feelings, sometimes taunting each other with their ill success. Every animal present sang of his own characteristics, and so the foundation of the present animal songs of the kesichay was laid. When the blanket is put up, the holders of the ball sing a chant to the effect that "the old screen hangs in front, the old screen hangs in front," repeated many times. The bear, the dog, the owl, every bird and animal known to the Navajo, has some appropriate song that is sung in the game.

The game between the nocturnal and the diurnal animals developed into a round of taunting songs, flung from one side to another, until some one called on the raven. He sang a song of the morning, and cried that the dawn had come, when the eastern sky began to be filled with light; and with a mingled cry of disappointment the nocturnal animals fled to their homes, scattering the articles used in the game, which was thus brought to an undecided end. For this reason the alternation of night and day has never been changed.

The moccasons used belonged to the bear, who, in his hurry, put them on wrong, thus giving his feet their peculiar shape. The sun shone on him before he reached his den, and turned his black coat to a reddish brown, which is its color now.

A Navajo Indian will not kill a snake, but, if one is encountered, will put a stick beneath it and toss it away: so, if a snake come into the tent where the kesichay is being played, it is tossed from one side to the other by the opponents, in the hope that it will bring bad luck to those with whom it stays.

ELECTRICAL NEWS.

The Use of Condensers in distributing Electricity.

TWO patents have been lately issued in which condensers are employed to reduce from a high to a low potential, in place of transformers or storage-batteries. One of these plans has been already described in this journal, and an objection to it was pointed out. Briefly, it consisted in charging a condenser of comparatively small capacity to a high potential, discharging it into a much larger condenser, thereby decreasing the potential, and finally discharging the latter through the lamp-circuit. This operation was continuously and rapidly performed. One objection that was pointed out lay in the great capacity that would be required for the large condenser. Another objection lies in the great waste of energy. The energy of the smaller condenser before it is connected with the larger is

$$\frac{1}{2}\frac{m^2}{c},$$

where m is the quantity of electricity on it, and c is its capacity. After it is discharged into the larger condenser, the energy of the two is

$$\frac{1}{2}\frac{m^2}{c+c_1},$$

where c_1 is the capacity of the latter. If we wish to reduce our potential from 2,000 volts to 100, c_1 must be $19\,c$, and the energy in the last case is only one-twentieth of that in the first, the difference having appeared as heat in the conductor connecting the two condensers. We have, in fact, an efficiency of only five per cent.

Another condenser apparatus for reducing from a high to a low potential has been patented by W. J. McElroy. The groups of sheets of which the condenser is made are of two sizes, the smaller size being connected with the main line, while the larger are connected through the lamp-circuit with the earth. The main line is supplied by an alternating current. The inventor describes the result as follows: "The electro-motive force available for the consumption circuit is easily regulated or set by the relative sizes of the sheets in the respective sides of the condenser, — the larger the difference, the lower the induced electro-motive force, — and the number of sheets will depend on the current strength needed for the particular circuit supplied. . . . For example: if it be desired to carry on the main line a current of 1,000 volts, and to supply a current on the consumption lines of 100 volts, then the size of the sheets on the one side must bear the proper proportion to those at the other side."

If we consider for a moment what the potential of the sheets on the consumption side will be, we see, in the first place, that, if they are not connected in any way with the earth, their potential will be that of the high-potential plates. If they are directly connected with the earth, their potential will be always zero, and, according as they are connected to the earth through a high or low resistance, their potential will be high or low. As for the increased size of the sheets connected with the lamp-circuit, it has nothing at all to do with the phenomenon, and the effect would be approximately the same if they were reduced to the size of the small sheets. It would not be difficult to calculate whether the system would regulate itself, but it is hardly in place here. Some of the objections to it, outside of the question of regulation, lie in the size of the condensers required, and in the fact, that, if only a few lamps are in use, it would be almost as dangerous to touch the lamp-circuit as the dynamo-circuit.

THE ACTION OF ELECTRICITY ON THE VESICLES OF CONDENSED STEAM. — M. J. L. Soret describes the following interesting experiment in the *Archives des Sciences*: In a dark room a platinum cup containing water is placed on a metal support, which is connected with one pole of a Topler machine. Above this cup a metal point is placed, which is connected with the other pole of the machine. A Bunsen burner boils the water in the cup, which is powerfully illuminated by the projection of a large pencil of the electric light. As long as the Topler machine is at rest, the vapor vesicles ascend in the ordinary way; but, as soon as the machine is at work, the action of electricity on the vapor is manifested in a most striking manner. For a certain distance from the point to the surface of the water the clouds collect, and whirl along the edge of the cup; under the influence of the electric light, they look to a certain extent like flames. If the point is brought a little nearer the water, the vapor disappears completely, although the water continues to boil briskly.

COMMELIN, DESMAZURES, AND BAILHACHE STORAGE-BATTERY. — M. Reymer, in his recent work, 'L'accumulateur Vol-

taique,' describes this novel and promising battery. The positive electrodes are porous plates made by submitting finely divided copper to a pressure of 600 kilograms per square centimetre. The negative electrodes are tinned iron plates, which are amalgamated, the object of the tin being to hold the mercury, which does not adhere to iron. The receptacle is made of tinned sheet steel. The negative electrode rests on the bottom of the box, with which it is in contact. The following table shows the composition of the electrolyte: —

Water	1,000.00
Zinc	144.67
Potash in solution	209.82
Potash, free	313.72

The positive electrodes are enveloped in parchment paper, and are insulated from the negatives by glass rods. Without the parchment, the action is irregular, the oxidation of the positive is not complete, and deposits of zinc are mixed with the copper: hence want of adherence, and local action or short circuits through the formation of 'trees,' as in other batteries where metallic deposition takes place. The following data are the results of tests made in the laboratory of the inventors: —

Weight of cell in working order	22.05	pounds.
" " 5 positive plates	4.25	"
" " 6 negative "	2.32	"
Height of positive plate	11.02	inches.
Width " " "	4.92	"
Height of negative plate	11.81	"
Width " " "	4.92	"
Surface of positive	54.22	sq. m.
" " negative	58.10	"
Length of receptacle	5.90	inches.
Width " "	3.35	"
Height " "	15.75	"
Weight " "	2.20	pounds.
Electrolyte (specific gravity, 1.55) weight	13.224	"
Useful electro-motive force	.75	volt.
Current, charging	15	ampères.
" discharging	48	"
Time of charging	30	hours.
" " discharging	9.5	"
Useful capacity	413	ampère hours.
	.42	H.P. hours.
Capacity per pound of cell	18.72	ampère hours.
	14.12	watt hours.
Weight per horse-power hour	52.47	pounds.

According to a note of M. Krebs, however, the total weight of battery for a horse-power hour was found to be 87.55 pounds.

THE EDISON ELECTRIC-LIGHTING SYSTEM IN BERLIN. — According to *Industries*, the work of the Edison Company in Berlin has been so successful that the public and the municipal authorities have perfect confidence in their ability to extend their central-station work still further, and a concession has been given for the establishment of two new stations. Both stations must be ready within two years, and each must be able to supply current for 6,000 glow-lamps burning simultaneously. The capacities of the two stations are to be eventually increased to 24,000 and 12,000 lamps. The network of cables to be laid down in connection with these stations is very complete, and practically comprises all the streets of the respective districts, some small side-streets alone excepted. In view of this extension of their business, the Edison Company propose to increase their share capital at present by $750,000, and later on by $1,500,000. The supply of current within the districts to be lighted will be compulsory, provided the customer is willing to take the light for at least one year.

THE EICKEMEYER DYNAMO. — The *Electrical Review* contains a description of a dynamo which has just been built by Mr. Eickemeyer, to be used in 'forming' the plates of storage-batteries. The novelty of this machine lies in the fact that both the armature and magnet coils are surrounded by a heavy casing of cast iron. The advantage of the type lies in the fact that there is no chance for lines of force to take any other path than through the armature, so that all magnetic leakage is avoided. The dynamo is to give 40 ampères at 1,000 volts. Its weight is 6,000 pounds, the principal part of which is in the cast-iron casing. The armature is of the drum type, 18 inches in diameter by 15 inches long. There are 240 turns of No. 11 wire, making a single layer on the armature. The machine is shunt-wound, and the following data are given as to its performance: —

Armature	240 turns, 1,560 feet No. 11 wire.	
" resistance	0.57 ohms.	
Field	14,880 turns, No. 21 wire.	
" resistance	1,600 ohms.	
Speed	850 revolutions.	
Electro-motive force at terminals	1,000	volts.
" " " per foot of wire	1.28	"
Current in external circuit	40	ampères.
" " field	.625	"
" " armature	40.625	"
Energy absorbed in field	612	watts.
" " " armature	912	"
" " " friction, etc	600	"
Net commercial efficiency	94.5	per cent.

The machine is said to run beautifully, with no sparking at full load. Its efficiency is more than good; and the dynamo is simple in construction, and cheap.

TRIAL OF AN ELECTRIC LOCOMOTIVE AT BIRMINGHAM, ENGLAND. — The following description of a trial of an electric locomotive is given in *Industries*: "The trial trip of an electric locomotive for drawing the tram-cars of the Birmingham Central Tramways Company took place in the presence of a large number of representatives of the press, the corporation, and of the various tramway companies. The engine itself, weighing eight tons and a half, has been constructed upon the Julien system by Messrs. Elwell-Parker. In the trial the electric locomotive successfully replaced the steam-tram engine now in use upon the Birmingham tramways. The gradients in many places are steep, rising to 1 in 17; but the electric locomotive successfully mounted this steep and long ascent with a load of sixty passengers, at a speed of about five miles an hour. On the level and down hill the speed could be increased to ten miles an hour without difficulty; and the locomotive was started, stopped, and backed with ease. The engine itself is a very neat and compact arrangement, compared with the ordinary tram-engines. Two rows of accumulators occupy each side, between which is the alley for the driver, where is fixed the switch, the reversing-switch, the engine-brake, and the car-brake. The switch connects the cells in five sets, all parallel, and two, three, or four in series. The cells number 104, having 39 plates, each 9 inches by 6 inches. The motor is placed low down, and is connected to the axles by helical gearing, — geared 1 to $8\frac{1}{2}$. The engine is capable of exerting 40-horse power, and will run sixty or seventy miles. A contract has been entered into by the engineers to run this car for three months at twelve cents per car-mile, the present cost of steam being nearly sixteen cents.

ELECTRIC-LIGHTING. — The establishment of central stations for the distribution of incandescent electric-lighting has received a noticeable impetus through the successful introduction of the alternating current and transformer method of distribution. The saving in the cost of conductors effected by this method, due to the employment of relatively high potential currents in the mains, has rendered it commercially practicable to distribute over much larger areas than formerly, but over areas of relatively sparse consumption. Thus many small towns are enabled to maintain successfully electric-lighting stations. The Westinghouse Electric Company of Pittsburgh, Penn., introduced the alternating-current system here, after careful and thorough investigation and experiment, about two years ago, installing the first commercial station at Buffalo, N.Y., and putting it in operation Thanksgiving Day, 1886. The number of central-station plants since supplied or contracted for by the Westinghouse Company has reached no fewer than one hundred and twenty-four. They have recently received a contract for a station in the heart of London, to include an outfit for twenty-five thousand lamps. This contract is with the Metropolitan Electrical Supply Company, Limited, the organization of which in London was noticed in electrical journals some months since.

AN ELECTRIC SURFACE ROAD IN NEW YORK. — The Bentley-Knight Electric Railway Company will soon resume operations on the Fulton Street cross-town railway in this city, and expect to have it in operation before the end of this month. They began work on the road over a year ago, but, owing to the opposition of a

street-railway whose track extended over a part of the route, they were unable to proceed far with the work at that time. In the Bentley-Knight system the electric current is taken from conductors contained in and protected by sub-surface conduits, — a system admirably adapted to the crowded thoroughfares of a busy city.

COMMERCIAL GEOGRAPHY.

The Obi Railroad.

THE question of opening the interior of Siberia becomes more and more important. While hitherto the canals between the large rivers, and projects of navigating the dangerous Kara Sea, were foremost among the plans that seemed likely to be realized, the project of a railroad from the lower Obi to the coast west of Nova Zembla has at present assumed definite shape. The Russian newspapers give the following reports of the project: The Obi Railroad, the most northern road ever planned, will be of the greatest economic importance to Siberia. It deserves special attention, as the projectors do not demand any subsidy or government guaranties. The river Malaia-Obi, near Obdorsk, is the starting-point of the projected line, which will take a direction towards the foot-hills of the Ural Mountains. The latter will be crossed in one of the transversal valleys, which are not over one hundred feet above sea-level. It will cross the river Ussa near its source, and reach the ocean through the tundra of Bolchesemelsk. Its terminus will be in the Bay of Shainoudir, near Belcoff Nosse. The total length of the line will be 260 miles. The price of construction, including rolling stock, is estimated at forty thousand dollars, or ten million dollars the whole line. The establishment of a port on the Arctic Ocean in the locality mentioned above, with all modern improvements for loading and unloading vessels, is estimated at one and a half million dollars. To this must be added the cost of establishing a line of river-boats on the Obi and Irtish, which is estimated at two and a half million dollars. Thus the whole plan requires the expenditure of fifteen million dollars in works of construction.

It is believed that the line can be worked for six months of the year. The products of the remotest parts of the Obi basin will be carried to the shipping port on the ocean in twelve days, while twelve days more will be sufficient to carry them to London. The price per hundredweight is estimated at $1.30; while on the present route, *via* Barnaul, Perm, St. Petersburg, London, it is $2.25, the time necessary to accomplish this distance being 130 days.

The railroad, which has been projected by Mr. Golovacheff, is intended as a means for making the transactions of a Siberian commercial company, which has been founded recently, profitable. According to the concession granted by the Russian Government, this road will not be open to the public, but will only be used by the grantee, who proposes to export the grain and stock from southern Siberia, and hopes to be able to furnish the London market with north Siberian fish. On the other hand, the company will import principally machinery, which so far has hardly found its way to Siberia, and other articles which are at present imported by Moscow merchants.

NOTES AND NEWS.

SCREENED from the world by a high fence, and not far from the Edison Laboratory at Orange, N.J., there have gone up two large factory-buildings. In these buildings there are now in operation a hundred thousand dollars' worth of such fine machinery as can be supplied by E. E. Garvin & Sons of New York, Pratt & Whitney and Dwight Slater of Hartford, and Brown & Sharpe of Providence, in the manufacture of the parts of the improved phonograph. The assembling of these will begin at an early date, so that by Jan. 1 one hundred phonographs should be leaving the works each day. Lieut. F. W. Toppan, U.S.N., is the manager.

— Lieut. D. Bruun of the Danish army, says *Nature*, having had a moss dug out in Finderup, in Jutland, has made some discoveries. In the moss were found trunks of oak, beech, and fir trees from 6 to 30 inches in diameter. The branches had in some cases been cut off, but the bark remained. By the side of one of the oak trunks two earthen vessels were discovered, and near another a third, shaped like an urn. In the latter lay a sandal cut from a piece of leather, with flaps, and leather straps for tying to the ankle the length of the sandal being 7 inches. It seemed as if the trunks of trees had been placed in a certain position for some purpose or other. About 20 feet farther to the south, and at the same depth, viz., 6 feet, a yoke of oak was found, $5\frac{1}{8}$ feet long and 3 inches thick, being fairly cylindrically cut out in the centre. At each end, were holes, in one of which remained a strap of leather. Other implements of oak were also found, evidently used for carrying. Some of them seemed part of a wheel. Close to the yoke another earthen urn was discovered, which, like the three referred to, was surrounded with sprigs of heather and bramble. Formerly some horns of bullocks and the skeleton of a man in a fur coating were found in the moss. The various objects are now in the Copenhagen Museum, and are said to date from the early iron age.

— Mr. J. W. Osborne of Washington, the well-known inventor of photo-lithography, has presented to the United States National Museum and to the Art Museum in Boston his large and exceedingly valuable collection of proofs and specimens illustrative of the development of photo-mechanical printing. All the important and typical processes are fully represented in each by specimens collected by Mr. Osborne in all the art centres of Europe and America, and include the works of all who have in any measure achieved success in the graphic arts. As soon as it can be properly classified, the collection intended for the National Museum will be placed on exhibition in the section of graphic arts. Mr. Osborne's contribution, the museum authorities assert, has laid a substantial foundation for an exhaustive collection of kindred productions under government auspices at Washington.

— The Philosophical Society of Washington will hold a meeting on Saturday evening, Dec. 8, at which an address will be delivered by the retiring president of the society, Col. Garrick Mallery, on 'Philosophy and Specialties.'

— According to news received in Denmark, Dr. F. Nansen has succeeded in crossing Greenland, but unfortunately was too late to catch the last steamer. It will be remembered that on July 15 Dr. Nansen, accompanied by Lieutenant Sverdrup, two other Scandinavians, and two Lapps, left the whaler 'Jason' in latitude 65° north, in sight of the east coast of Greenland. After twelve days of difficult march across the pack-ice, the coast was reached, but about sixty miles farther south than Dr. Nansen expected to land, the current having carried the ice southward. On Aug. 15 the party began the march across the inland ice, taking a north-westerly direction towards Christianshaab. When a height of about 7,000 feet was attained, the travellers were overtaken by a northerly snow-storm, which compelled them to take a westerly course toward Godhaab. The greatest altitude attained was about 9,500 feet. Finally, after forty-six days of travel, the party arrived at the head of Ameralik Fiord, which is situated a little south of Godhaab, and, by means of an improvised float, Godhaab was reached on Oct. 4. Dr. Nansen despatched immediately two kayaks with letters to Ivigtut, from which place the steamer 'Fox' was to leave about this time. The kayaks reached this place when the steamer was about to leave, and as the captain did not feel justified in delaying his departure, on account of the advanced season, the party will have to winter in Greenland.

— At the meeting of the Royal Meteorological Society held on Nov. 21, Mr. G. J. Symons read a paper entitled 'Results of an Investigation of the Phenomena of English Thunder-storms during the Years 1857–59.' This paper was written nearly thirty years ago. It has now been communicated to the society at the request of the thunder-storm committee. The paper contains a summary, chiefly in statistical form, of some of the results of an investigation into English thunder-storms, and the accidents produced by lightning during the years 1857–59. The author found that in sheet lightning the most prevalent color is white, then yellow, blue, and red; in forked lightning the order is nearly reversed, blue being more than twice as frequent as any other color, then red, white, and most rarely yellow. Sheet lightning was seen about twice as often as forked. Dr. A. Riggenbach exhibited some photographs of cirrus and other fine clouds, which had been obtained by using the surface of a lake as a polarizing mirror.

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CONTENTS:

THE GREAT EXTENT OF FORESTS in the State of New York, and their devastation, that has been going on continuously, have led to repeated endeavors to protect them from unlawful cutting-down and wasteful practices. For this purpose the New York State Forestry Association was founded in 1885, and did much to get the well-known forestry law passed by the Legislature. Since that time, however, the association has failed to show a vigorous life. At present renewed endeavors are being made to establish the association as a working body for the purpose of disseminating knowledge on the importance of forests, and for promoting measures to secure their proper protection. The New York Academy of Sciences devoted its meeting last Monday to this subject; and the proposed steps, which were explained by Professor Southwick of the New York State Forestry Association, found general indorsement in the discussion following Professor Southwick's remarks. The object is one of great economic importance to the State, and, as Dr. H. Nicholas Jarchow, the first speaker of the evening, remarked, the forests forming a portion of the public domain ought to be a source of considerable income instead of causing expense. He continued, "It would be very advantageous to establish a forestry school in or near the Adirondacks. Its cost would not be large, especially if adjoining States, having much the same climate and varieties of trees, would combine to support a school. Moreover, the labors of the students would nearly pay expenses, and, once graduated, there would be a demand for their services from all parts of the country. Congress has made a national recommendation on the subject; but Congress is slow to act, and the States should provide for themselves in the matter. Trained foresters would take an honest pride in their work, and put their hearts in it. They would save valuable lumber, prevent great thefts of timber, and break up the present state of affairs, with all its disadvantages." Experience has shown that the last act of the Legislature, although a step in the right direction, has not the desired effect: therefore all measures taken for inducing the Legislature to organize a good forestry board, with ample means for carrying on its important work, and attempts to spread an intelligent knowledge of the importance of forests and of their economic value, must be highly welcomed. The New York Academy of Sciences has done well to bring the subject once more before the public, and it is to be hoped that the meeting will be of help to the attempted re-organization of the State Forestry Association.

BOOK-REVIEWS.

A Short Account of the History of Mathematics. By WALTER W. R. BALL. London and New York, Macmillan. 12°. $2.60.

MR. BALL, who is a fellow and assistant tutor of Trinity College, Cambridge, offers in this compact volume a transcript of his lectures delivered in the spring of the present year on the history of mathematics. While technical and exact enough to be of value to the specialist in mathematics as a handy book of reference, it is so clearly and familiarly written, that it is the best work on this subject for the general reader that we know of.

The region of mathematics is a *terra incognita* to most persons, even those who consider themselves possessed of a good general education; and this, despite the fact that mathematics as a mental discipline is unsurpassed, and is unrivalled for the beauty and grandeur of its results. Having for its foundation the two universal and necessary forms of perception, space and time, mathematics developed, naturally enough, in the early stages of reflective thought. To trace the growth of its conceptions in clearness and perspicuity, and to follow up the increasingly complex and varied forms of symbolism, is the work of the history of the science, and Mr. Ball's treatment of it is eminently successful.

After a summary notice of what we may call the prehistoric period of the science, mathematics as understood and taught by the Egyptians and Phœnicians, the author makes a tripartite division of the subject,—mathematics under Greek influence, the mathematics of the middle ages and the renaissance, and modern mathematics. Of the first period, Pythagoras, Euclid, Archimedes, and Ptolemy are the most important representatives. The *quadrivium* of the mediæval schools is traced back to the division of knowledge adopted by the Pythagorians,—numbers absolute, or arithmetic; numbers applied, or music; magnitudes at rest, or geometry; magnitudes in motion, or astronomy. In a chapter on 'Systems of Numeration,' after the prominent names in this first period have been discussed in chronological order, Mr. Ball gives an interesting account of the early methods of counting, and the introduction of the abacus. In his mention of the use of this instrument, we should have been glad to find a more extended notice of the form of it in use among the Chinese, and some further explanation of the very complicated computations which they perform by its aid with great celerity and accuracy.

In the second period, most of the mathematicians were astronomers; but the period includes the introduction of Arabian mathematical works and the results of Arabian thought into Europe. In reference to this, Mr. Ball says, "It was from Spain, and not from Arabia, that Arabian mathematics came into western Europe. The Moors had established their rule in Spain in 747, and by the tenth or eleventh century had attained a high degree of civilization. Though their political relations with the caliphs at Bagdad were somewhat unfriendly, they gave a ready welcome to the works of the great Arabian mathematicians. In this way the Arab transla-

tions of Euclid, Archimedes, Ptolemy, and perhaps of other Greek writers, together with the works of the Arabian algebraists, were read and commented on at the three great Moorish universities or schools of Granada, Cordova, and Seville. It seems probable that these works represent the extent of Moorish learning; but, as all knowledge was jealously guarded from any Christians, it is impossible to speak with certainty either on this point or on that of the time when the Arab books were first introduced into Spain" (p. 157).

A good summary of the condition of mathematical knowledge at the close of the renaissance is given at p. 228: "By the beginning of the seventeenth century we may say that the fundamental principles of arithmetic, algebra, theory of equations, and trigonometry had been laid down, and the outlines of the subjects as we know them had been traced. It must, however, be remembered that there were no good elementary text-books on these subjects; and a knowledge of them was thus confined to those who could extract it from the ponderous treatises in which it lay buried. Though much of the modern algebraical and trigonometrical notation had been introduced, it was not familiar to mathematicians, nor was it even universally accepted; and it was not until the end of the seventeenth century that the language of the subject was definitely fixed. . . . If we turn to applied mathematics, we find, on the other hand, that the science of statics had made but little advance in the eighteen centuries that had elapsed since the time of Archimedes, while the foundations of dynamics were only laid by Galileo at the close of the sixteenth century. In fact, it was not until the time of Newton that the science of mechanics was placed on a satisfactory basis. The fundamental conceptions of mechanics are difficult, but the ignorance of the principles of the subject shown by the mathematicians of this time is greater than would have been anticipated from their knowledge of pure mathematics. With this exception, we may say that the principles of analytical geometry and of the infinitesimal calculus were needed before there was likely to be much further progress. The former was employed by Descartes in 1637; the latter was invented by Newton (and possibly independently by Leibnitz) some thirty or forty years later: and their introduction may be taken as marking the commencement of the period of the modern mathematics."

That which follows is more familiar, and the feature of Mr. Ball's chapters on the modern period is his full and clear analysis of Newton's contributions to mathematical science. Descartes, Pascal, Barrow, Huygens, Newton, Leibnitz, the Bernoullis, Euler, Lagrange, Laplace, Legendre, Poisson, and others less important, are treated in turn and with excellent judgment. Their successors are very briefly mentioned, and no attempt is made to follow out in detail the researches of Abel, Gauss, Sir William Rowan Hamilton, Henry J. S. Smith, Weierstrass, Cayley, Sylvester, and Klein. But from this history, or historical sketch, the intelligent reader can gain a very complete view of the progress of mathematical science from its beginnings until its contemporary differentiation into numerous specialties, — each of them important and difficult enough to detain for a lifetime a brilliant mind, — all of which are fruitful in their applications to the various phases of modern science and modern industry.

A Brief History of Greek Philosophy. By B. C. BURT. Boston, Ginn. 12°. $1.25.

THIS work had its origin, the author tells us, in a series of articles in a religious newspaper, but has been expanded so as to cover the whole history of Greek speculation from Thales to Proclus. The result is a volume of three hundred pages, in which the leading doctrines of the various schools are concisely yet for the most part clearly presented. Mr. Burt's style is plainer than that of most writers of the school to which he belongs; and his readers will seldom have any difficulty in understanding what he says, except where the theories he is trying to explain are themselves obscure. The main fault in the book, according to our view, is the author's Hegelianism. This leads him not only to look in the ancient thinkers for anticipations of his own views, but also to give too much attention to some theories of the earlier philosophers and of the Neo-Platonists which can only be regarded as products of imagination. What we want to learn about the ancient philosophers is their contributions to the real philosophies of the world; while their visionary theories, which they themselves in many cases put forth as only conjectural, ought to be passed over in silence, or with a bare mention. In the main, however, Mr. Burt has confined himself to the best portions of Greek thought, the great names of Socrates, Plato, and Aristotle necessarily occupying the foremost place, yet without excluding what is most important in the works of others. The exposition of Aristotle is excellent, though the treatise on 'Politics' is accorded rather too much attention; but the account of Plato is hardly so satisfactory. The author's view of the periods of Greek thought is essentially that now commonly held. The first period was that of naturalism, or the attempt to explain the physical world; the second, that of rationalism, or the endeavor to understand human nature and discover the basis of morals; while in the third or Neo-Platonic period theological speculation held the leading place. Of these different phases of thought, the second is so much the most important that the exposition of it rightly occupies the greater part of the volume; yet the others receive all the notice that is necessary in so compendious a treatise. Mr. Burt is careful also to trace the connection of each period with the preceding one, and also of one individual thinker with another, thus exhibiting the course of philosophical development. On the whole, the book is well adapted to its purpose, and will undoubtedly be useful to young students, in college and elsewhere, for whom it is more especially intended.

Paradoxes of a Philistine. By WILLIAM S. WALSH. Philadelphia, Lippincott. 16°. $1.

THIS volume consists of a number of short essays, most of which had previously appeared in certain periodicals. The author remarks that the word 'paradox' "is usually held to be a synonyme for flippant smartness," but that it really means a proposition that seems absurd but is nevertheless true in fact. His own paradoxes, however, hardly answer to either of these definitions; for only a perverted intelligence could regard the mass of them as true, and, though they are flippant enough, we fail to see any 'smartness' in them. The book is a continuous sneer at men of genius and at intellectual and moral superiority of every kind. Mr. Walsh maintains that "men are more nearly equal than we suppose," and that "there is no such great difference between a genius and a dunce." "The great historian, the great poet, the great statesman, the great philosopher, . . . are as fallible and as foolish . . . as you and I are. The intellectual feats that they perform only happen to be more difficult to the average man, that is all." He endeavors to sustain this view by citing examples of follies and sins committed by men of genius; but most of the men he refers to were not geniuses at all, but commonplace men who followed the profession of literature. The author adopts a cynical tone throughout, which adds to the disagreeableness of what he says. Moreover, there is hardly any thing of a different character in the book, except some fantastic remarks on 'The Sense of Pre-existence,' and a few pages about 'Mother Goose.' Mr. Walsh says that he has collected these papers into a volume, "because the author likes them," and the world will probably be willing to grant him the exclusive enjoyment of them.

The Critical Period of American History. By JOHN FISKE. New York, Houghton, Mifflin, & Co. 12°. $2.

THIS book consists of lectures delivered first in the Old South Meeting-House at Boston, and afterwards in other cities. It relates to the time between the close of the revolutionary war and the adoption of the Federal Constitution, which Mr. Fiske justly regards as the most important period in our national history. Our popular historians are apt to give altogether too much attention to wars and other stirring events, and too little to the quieter but more influential movements of political and constitutional reform. Mr. Fiske, however, has a much better idea of the historian's duty, and has accordingly given us a much better book than most of his predecessors have done. His philosophical studies have given him the comprehensiveness that good historical writing requires, and have fitted him to trace with clearness the chain of causes and effects which is the fundamental fact in historical development. His style, too, with its clear and easy flow, is well fitted for the

conveyance of historical truth, and never leaves the reader in doubt as to the author's meaning. The result of these qualities is that the book presents a large amount of information in a plain and easily understood form; and, though it contains a great many details, they appear in the main as essential parts of the narrative, and not as isolated and insignificant facts.

Mr. Fiske opens his work with an account of the negotiations for peace between Great Britain and the United States, and then goes on to describe the condition of the several States at the time, and the political changes that took place in them after the attainment of their independence. The most important parts of the book, however, are the third and fourth chapters, dealing with the general state of affairs in the years succeeding the peace, the alarming tendency towards anarchy, and the utter inadequacy of the Confederation to furnish a stable government. Mr. Fiske makes it perfectly clear, that, if things had been left to take their own course, the Confederation would in a short time have broken up, and that it was the gradual but sure perception of this fact that paved the way for a stronger central government. The prejudice at first existing against such a government was dissolved by the logic of events, and then the good sense and patriotism of the people came to the rescue. Such a Constitution as ours, however, could not have been framed except by men of the highest political genius, and even the soberest thinkers will not regard Mr. Fiske's encomiums upon them as exaggerated. In his account of the Federal Convention, however, the author seems to us to have given too little attention to what is really the essential feature of our system of government. The most vital and most original part of the Constitution is the division of powers between the State and the Federal governments, and it is also the most perfect part; yet Mr. Fiske has less to say about this part of the scheme than about any other. But there is little to criticise in the book, and we cannot but hope that its author will give us other works of a similar character, and that other historical writers will come more and more to follow the same method of treatment. The American people need all the political instruction they can obtain, and books dealing with history, as this book does, in a philosophical manner, are among the best of political teachers.

Astronomy with an Opera-Glass. By G. P. SERVISS. New York, Appleton. 8°. $1.50.

THE greater part of the matter composing this volume appeared originally in a series of articles published in *The Popular Science Monthly*. The author points out the interesting phenomena of the heavenly bodies that are visible, with little assistance from optical instruments, and thus gives an interesting and valuable introduction to the study of astronomy. Although nothing has been described as visible that cannot readily be seen by means of an opera-glass or a small field-glass, enough of the discoveries made by means of powerful telescopes has been stated to lend due interest to the subject, and to instigate the observer to further studies. The book has been written for the purpose of being a guidance to the observer. For this reason the matter has been arranged according to objects visible in each season, the stars of spring, summer, autumn, and winter each being treated in one chapter. Observations of the moon, the planets, and the sun are described in the last chapter of the book. In an introduction the requirements of a good opera-glass are set forth. The work is well adapted to exciting interest in astronomy, and imparting such knowledge of the heavenly bodies as must form the foundation of intelligent study of the results obtained by means of powerful telescopes.

American Weather. By A. W. GREELY. New York, Dodd, Mead, & Co. 12°.

THE object of the present work is to give clearly and simply, without the use of mathematics, an idea of meteorology. The introductory chapters treat briefly the methods of measuring atmospheric pressure, temperature, and other meteorological phenomena, while the rest of the book is a detailed climatology of the United States. The various phenomena are fully discussed, and illustrated by numerous maps, which convey a peculiar interest to the book. The vast amount of material collected by means of the Signal Service and the State meteorological services has been made use of, and makes the book a very complete and comprehensive review of the climatology of the United States. The work is not merely a compilation of the work of other authors, but General Greely frequently takes occasion to put forward his own views, particularly in the chapters on storm-tracks. The principal merit of the book is the concise and clear treatment of the matter, which will enable every one interested in meteorological phenomena to understand the peculiarities and diverse character of American climate in various parts of the country. We hope it will contribute towards creating a greater appreciation of meteorology, and of its importance to the interests of American agriculture and industries. Some of the maps are particularly well adapted to show these applications of meteorology: among them we mention the maps of first and last killing frosts and the maps showing continuance of mean daily temperatures above 32° and 50°. The book forms a handy volume. It is well printed and illustrated, and is an excellent treatise on American weather. In the clearness of its method, it may be compared to Mohn's well-known 'Elements.'

The Writer's Handbook. Philadelphia, Lippincott. 12°. $2.50.

THIS book consists of three distinct parts, written apparently by three different writers. All the writers are evidently British; but who they are, nothing on the titlepage, or elsewhere in the book, enables us to say. The first part of the volume is an elementary treatise on composition and rhetoric, with a series of extracts illustrating the history of English style. The matter of this part is in the main good; though the author, like most rhetoricians, dwells too much on the merely mechanical qualities of style, and too little on the moral and intellectual ones. The subject of figurative language, too, is insufficiently treated, the important figures metonymy and synecdoche being wholly neglected. But the author's remarks on style, though covering but a portion of the ground, are pretty good as far as they go. They will not help the young writer much in acquiring the good qualities of style; but they will, if heeded, enable him to guard against many defects. The author's own style is not in all respects a model; for, though it is correct and clear, it has a certain mechanical character, and some paragraphs read like a succession of aphorisms. The samples of English prose are not always such as we should have chosen; for, though they illustrate fairly well the history of style, some of them are by no means models of good style, and for learners this latter consideration is the more important. The second part of the book is another treatise on composition, only one-third as long as the first, but superior in quality. It covers but a portion of the ground usually occupied by such works; the subject of figures, for instance, being omitted altogether. But it sketches in plain though brief terms the leading qualities of style, and gives some useful hints as to the best mode of acquiring them. The third and concluding part of the book is confined to the subject of letter-writing; and it seems rather out of place in this collection, for, though it may be useful to those who write nothing else than letters, it can hardly be of much service to those who have read the other parts of this book.

The Death-Blow to Spiritualism: being the True Story of the Fox Sisters as revealed by the Authority of Margaret Fox Kane and Catherine Fox Jencken. By REUBEN BRIGGS DAVENPORT. New York, G. W. Dillingham. 16°. 50 cents.

THE last phase in the sad but ridiculous story which this volume tells is perhaps the pleasantest, or, better, the least displeasing. Forty years after two mischievous girls in a lonely country house undertook to frighten their mother by a series of midnight tricks, the same girls, now as mature women, confess to the world that the unparalleled psychic epidemic to which their pranks gave rise is all a fraud. The raps interpreted by credulous folk as the answers of inquiries to departed spirits are nothing less homely than the dislocations of the great toe. Beginning these raps as children innocent of the uses to which they were put, spurred on to deeper and deeper mischief by the marked attention given to them by weak-willed believers and the money-making proclivities of an elder sister, they soon found themselves the centre of an ever-increasing throng of enthusiasts, and in a position where it was dif-

ficult to retract. From such slight beginnings arose this stupendous movement of Spiritualism, developing one after another of alleged communications with forbidden spirits; adding cabinet *séances*, materializations, second-sight, and a host of modified conjuring-tricks, as proofs of supernatural agency, — a complete systematization, in which mediums and phenomena were explained with an insane logic and a morbid imagination; and, worse than all, the pitiable deception of countless simple-minded folk upon matters nearest and dearest to them. To this tale of constant opposition between fanaticism and science, the many investigations showing the groundlessness of these claims, we can now add the free and full confession of fraud on the part of the originators. The two heroines of the story are certainly to be praised for this avowal; and their romantic but hardly admirable career contains no better action than this. But whether this is really "the death-blow to Spiritualism" must be questioned. Such movements die slowly. Its adherents will claim an evidence independent of the Fox sisters, and ascribe to the latter mean and suspicious motives. As a writer on such topics has well said, men go mad in crowds, but they return to their senses only slowly and one by one.

AMONG THE PUBLISHERS.

THE *Century* for December contains a number of full-page engravings of sacred pictures by the old and little-known Italian master, Duccio. A striking feature is furnished by two articles on Henry Ward Beecher's appearance in England in 1863, in advocacy of the cause of the American Union. But the two contributions having perhaps the highest importance are the instalment of the life of Lincoln, entitled 'First Plans for Emancipation,' and the paper by Mr. Kennan in which he graphically describes 'Life on the Great Siberian Road.' In this number are the first of the stories of Irish-American life, by Mr. George H. Jessop, and one of Mr. Cable's literary 'finds' in the way of strange true stories under the title of 'Françoise in Louisiana.' In the same number is a timely paper on 'The Re-organization of the British Empire,' by Mr. George R. Parkin. In connection with Mr. Parkin's article is an Open Letter entitled 'Home Rule and Culture,' on the Irish aspect of re-organization, by Mrs. Margaret F. Sullivan. Henry James writes with full knowledge and critical enthusiasm a paper of which the pregnant title is 'London,' which paper has a running accompaniment of drawings by the well-known artist, Joseph Pennell. Edward L. Wilson gives his personal observations on the route 'From Sinai to Shechem,' accompanied by fifteen illustrations drawn mainly from his photographs. The 'Topics of the Time' are 'Christmas,' 'Progress of Ballot Reform,' 'Should there be an Aristocracy of Criminals,' and 'A Confusion in American Party Names.' In 'Open Letters' Mr. Ernest H. Crosby, of the New York Legislature, writes on 'Political Corruption,' suggesting the "formation of an American society for the promotion of political honesty;" and others of the 'Open Letters' deal with the 'Woman's Work' question, 'The Holt Method of Teaching Music,' and 'Herbert Spencer.' —— On Dec. 6 the *Independent* celebrated the completion of its fortieth year. Articles were printed from Dr. Richard S. Storrs, the only one of the original editors now living; by Henry C. Bowen, who is one of the two original proprietors now living; and by Dr. Samuel T. Spear, who was a contributor to the first number. —— The supplement in *Harper's Weekly* of Dec. 1 contains an article on 'Blizzards, Cyclones, and Tornadoes,' with illustrations by W. H. Gibson and others. —— The International News Company of Beekman Street have ready the Christmas numbers of the London *Chatterbox* and the London *Graphic*, the latter having two large-page colored supplements. Neither of these celebrated publications will disappoint the expectations of their great throngs of readers in all parts of the world. They are as good this year as ever. —— *The Book Lover* is the title of an attractive monthly journal published by William Evarts Benjamin, 6 Astor Place, New York, of which the first issue is dated November. —— The *Publishers' Weekly* says that a new feature in periodical magazines is announced in the *Magazine of Poetry*, a quarterly review, whose first number will be issued in January, 1889, — a magazine to be devoted exclusively to poetry and the study of poetry. Among the poets to be discussed in early numbers are Mr. Stedman, Mrs. Louise Chandler Moulton, T. B. Aldrich, Mr. Stoddard, Lowell, Holmes, Whittier, Boyle O'Reilly, Edgar Fawcett, and Edith Thomas. —— The *Political Science Quarterly* for December contains among its leading articles, 'A Study of the Influence of Socialism upon English Politics,' by William Clarke, an Oxford graduate and a London journalist; 'An Argument for Private Enterprise *versus* Public Business Management,' by Prof. Arthur T. Hadley; 'A Discussion of the Legality of Trusts,' by Prof. Theodore W. Dwight; 'An Analysis and Criticism of the Law of 1887, regulating the Electoral Count,' by Prof. John W. Burgess; 'An Account of the Practical Operation of the Official or State Ballot System in England,' by Mr. Edwin Goodby, a prominent Liberal politician; and 'A Summary of the Legal Questions which have arisen under the English Ballot Act,' by Mr. H. H. Asquith, M.P.

— The sixth and seventh instalments of Proctor's 'Old and New Astronomy' have been issued. The work continues to be full of interest. It is beautifully illustrated and printed. The present instalments treat of the phenomena of the sun, its corrugated surface, faculæ and spots, and the sun's surroundings. The last-mentioned part contains particularly illustrations of phenomena observed during total eclipses. In the latter half of the seventh instalment the description of the inferior planets is begun. We call particular attention to the beautiful plates, appended to the last instalment, showing a typical sunspot, a photograph of the sun, and of a total eclipse. —— Hartleben's great atlas, 'Die Erde in Karten und Bildern,' is almost complete. Forty instalments have been issued, and only ten more remain to be published. The last numbers contain an interesting colonial map, and another of the whole continent of America. The maps are very clearly engraved, and the topography is very good. The accompanying text, which is profusely illustrated, treats of the geography of Africa. In the following instalments the Arctic regions will be treated. —— Ticknor & Co. will publish Dec. 10 a work that will challenge the attention of the entire Christian world, Catholic or Protestant. This is the autobiography of the famous 'Nun of Kenmare' (Ireland), Sister M. Francis Clare (Cusack), whose services in the great Irish famine of 1879 are world-famous, and who is equally known and beloved for her long service of devotion and charity for the aid and elevation of working-girls. —— There has recently been published a work entitled 'Handbook of Stenotypy, or Shorthand for the Type-writer,' being a formulated system of abbreviated orthography for the use of type-writers and others. By the use of the Roman letters and the numerals, with which all are familiar, and without any occasion whatever of possessing a knowledge of any system of shorthand writing, any operator, on any type-writing machine, may, by the use of stenotypy, systematized in this work, with but trifling study, practice only being requisite, become sufficiently competent to print from dictation directly on the machine, with a speed exceeding their ability at ordinary type-writing by thirty to fifty per cent. George Lane, 150 South Portland Avenue, Brooklyn, N.Y., is the address of the publisher. —— Prof. Henry Allen Hazen has published a useful 'Hand-Book of Meteorological Tables,' which will be welcome to all meteorologists, being a collection of the best tables, in compact form, convenient for use, and at small cost. All tables relating to the same subject are placed together so far as possible. Thus the matter is divided into tables relating to temperature, pressure, humidity, and wind. Linear tables for converting measures form the next part of the book, while the last part contains miscellaneous tables. Among these, those for dividing by 29, 28, and 31, will be found particularly useful. In an appendix meteorological normals for the United States are given. The handiness of the volume will make it a welcome help to the working meteorologist. Unfortunately there are a number of misprints, which, however, will doubtlessly be corrected in a second edition. —— Gen. C. W. Darling, corresponding secretary of the Oneida Historical Society at Utica, has compiled from manuscripts of public records a work which he entitles 'New Amsterdam, New Orange, New York.' It may be expected early next year, states the *Publishers' Weekly*. —— Thomas Whittaker will publish shortly 'Stray Leaves of Literature,' by Frederick Saunders of the Astor Library. —— The Forest and Stream Publishing Company announces

'Charley's Wonderful Journeys,' a new book by C. F. Amery. It belongs to the 'Alice in Wonderland' class of juveniles. —— Rev. James B. Converse, Morristown, Tenn., has in press 'The Bible and Land,' which, in the opinion of some, will "utterly rout and annihilate the most pernicious of Henry George's theories."—— "The Historical Society of Rhode Island," says Mr. S. S. Rider, in his Providence *Book-Notes*, "has issued a proposal for the publication of a map of the State, 'defining the territories of the Indian tribes, and the Indian names of localities therein, wherever they can be discovered.'" —— The J. B. Lippincott Company have published Amelie Rives's 'The Quick or the Dead?' in book-form. Miss Rives has written a preface for this edition, in which she explains her purpose in writing the book, and answers her critics in a trenchant but good-natured manner. —— D. Lothrop Company have published 'The Story of Louisiana,' by Maurice Thompson, the third volume in The Story of the States Series; 'Glimpses of Great Fields,' by Rev. J. A. Hall, designed to refute the materialistic theories of evolutionists; 'The Lost Earl, with other Poems and Tales in Verse,' twenty-one poems, narrative, satirical, imaginative, etc., by J. T. Trowbridge; 'The Story of the American Sailor,' from earliest times to the present, by Elbridge S. Brooks. —— D. Appleton & Co. will publish early this month 'From Flag to Flag: a Woman's Experiences and Adventures in the South during the War, in Mexico, and in Cuba.' The author, Mrs. Eliza McHatton-Ripley, was the wife of a planter in Louisiana. They will also publish a book on Florida, by Prof. James Wood Davidson, bearing the title 'Florida of To-Day: a Guide for Tourists and Settlers;' a posthumous work by Dr. W. B. Carpenter, entitled 'Nature and Man: Essays Scientific and Philosophical,' accompanied by a memoir written by J. E. Carpenter; an entirely new edition of Darwin's 'Origin of Species,' reprinted from the sixth and last London edition, which contains the author's latest revisions; and, in Appletons' Town and Country Library, a novel by Helen Kendrick Johnson, entitled 'Raleigh Westgate; or, Epimenides in Maine;' and a translation of Ernest Daudet's powerful novel, 'The Apostate.' —— Lee & Shepard have ready 'The Julia Ward Howe Birthday-Book,' edited by her daughter, Laura E. Richards; 'Aryans, Semites, and Jews, Jehovah and the Christ: a Record of Spiritual Advance from the Household or Personal God of the Semite Abram, and from Jehovah, the Tutelary or National God of the Israelites, to the Universal Father revealed by Jesus the Christ, with the Contracts made between the Household God and Abram, the Tutelary God Jehovah and the Israelites, and between "Our Father in Heaven" and all Mankind, also the Circumstances, Incidents, and Events attending the Preparation and Promulgation of the Second Revelation,' by an anonymous writer; 'Essays, Religious, Social, Political,' by David Atwood Wasson, with a biographical sketch by O. B. Frothingham; 'The Apostle of Burma,' a missionary epic commemorative of the centennial of the birth of Adoniram Judson, by William C. Richards; 'Incidents of a Collector's Rambles in Australia, New Zealand, and New Guinea,' by Sherman F. Denton, artist of the United States Fish Commission, Washington, D.C., with illustrations by the author; and 'Free Trade,' a speech delivered before the Democratic Club, Brussels, Belgium, Jan. 9, 1848, with extract from "La Misère de la Philosophie,' by Karl Marx, translated into English by Florence Kelley Wischnewetsky, with preface by Frederick Engels. —— Henry Holt & Co. are about to issue Sir Henry Maine's posthumous work on international law, which was in manuscript almost ready for the printers at the time of its author's death. The sheets have been seen through the press by Frederic Harrison and Frederic Pollock, two of Sir Henry Maine's executors. —— Charles Scribner's Sons announce that the date of the publication of their edition of Paul du Chaillu's 'Viking Age' has been postponed in consequence of the time required to manufacture a work of such magnitude. The illustrations will number over 1,200. —— The biography of John Stuart Mill by Mr. Courtney in the Great Writers Series will be published this month, and will contain a letter from Mr. Gladstone on Mill's career in Parliament. —— Professor Sayce of Oxford has gone to Cairo for the purpose of copying the cuneiform tablets which have been collected there. —— "A curiosity in the way of a dictionary," says the Boston *Traveller*, "has just been published by the Canadian Government. It is one of the Micmac language by Rev. S. T. Rand, D.D., of Hantsport, N.S. The aboriginal languages of North America have long been recognized by European philologists to be among the most perfect linguistic systems that are known; and among the Algonquin languages none is more perfect than that of the Micmacs, once a powerful body in that great ethnical division. Heretofore, however, there has been a great difficulty in studying these languages, because of the lack of aids, such as grammars and dictionaries, which are both supplied in Dr. Rand's work, so that the importance of the work to scholars will be evident." —— Worthington Company announce Ida Waugh's great artistic effort in a juvenile book, 'Bonny Bairns,' with 48 large quarto illustrations, every page in colors. The text is by Miss Amy Blanchard. This book by Miss Ida Waugh, author of 'Wee Babies,' and other popular books for children, will greatly excel in interest any book hitherto made by her. However beautiful her other books may have been, this will be found to be of more general interest than any of her previous works. —— The December number (No. 39) of the Riverside Literature Series (published monthly at 15 cents a number by Houghton, Mifflin, & Co., Boston) contains four carefully annotated papers by James Russell Lowell, — 'Books and Libraries,' 'Emerson, the Lecturer,' 'Keats,' and 'Don Quixote.' 'Books and Libraries' is an address delivered in 1885 at the opening of a free public library. It is of especial value to book-lovers, and a most valuable aid to those interested in collecting books for private or public use. 'Emerson, the Lecturer,' a delightful paper on the sage of Concord, is of great interest to lovers of Emerson, and forms a most helpful introduction to his works. The chapter on Keats is a charming biographical and critical sketch of one poet by another. 'Don Quixote,' a paper read before a workingmen's college at London, is a very entertaining essay on the worth and place of imaginative works in literature. This number of the Riverside Literature Series places within the reach of all a choice collection of complete selections from the works of a master of English prose. It is especially suitable for use in high schools and academies. —— The publishers of Worcester's Dictionaries, the J. B. Lippincott Company of Philadelphia, call special attention to the entirely new edition of their 'Academic Dictionary.' The 'New Academic' presents as a distinctive new feature the etymology of words. In this respect no other work of its class approaches it in fulness and completeness. In orthography great attention has been paid to usage, analogy, and etymology in deciding all disputable points. In pronunciation the book not only gives the preference of Dr. Worcester, but exhibits at the same time that of all the leading lexicographers. —— An interesting sketch entitled 'The New Africa' has been published by the Rev. Lansing Taylor. The pamphlet embraces a series of articles which have appeared in the *Methodist Review*. An interesting outline of the most recent exploration of Africa is given, particular stress being laid upon Stanley's work. The author gives a vivid picture of what he calls 'the three Kongos,' the Kongo, Welle, and Kasai, and finally attempts to draw the curtain from the unknown future of this vast and fertile region. He sees it crossed by railroads and canals, inhabited by an industrious Christian population, and taking an active part in shaping the fates of the world. The author takes the most hopeful view in regard to the rapidity of the progress of this region, and its aptitude for becoming a home for Europeans, and impresses the reader with his enthusiasm. It is to be feared that the opening of Africa will not be so rapid and easy a matter as the author wishes us to believe. —— The author of 'The Battle of the Swash,' which satirizes the American navy, is said to be James Barton, a nephew of the late Commodore Vanderbilt, and well known years ago in Wall Street. —— One of the rare books in American history is known as 'Loudon's Indian Wars.' The full title reads as follows: "A Selection of some of the most interesting Narratives of Outrages, Committed by the Indians, in Their Wars with the White People. Also, An Account of their Manners, Customs, Traditions, Religious Sentiments, Modes of Warfare, Military Tactics, Discipline and Encampments, Treatment of Prisoners, etc., which are better Explained, and more Minutely Related, than has been heretofore done, by any other Author on that subject. Many of the Articles have never before appeared in print. The whole compiled from the best Authorities, By Archibald Loudon." It fills two small 12mo volumes

of only 724 pages, all told. The imprints read, "Carlisle: From the Press of A. Loudon (Whitehill) 1808," and "Carlisle: From the Press of Archibald Loudon, 1811." Of this book the Harrisburg Publishing Company proposes to reproduce an edition, limited to one hundred copies, for subscribers, at ten dollars per set. Subscriptions sent to Charles L. Woodward, 78 Nassau Street, New York, will be numbered, and will be good until the list is full. —— Mr. Charles T. Strauss has published a condensed translation of 'Spelin,' a universal language, by Prof. George Bauer. The character of this new language may be understood from its name, which is derived from *s* (the prefix designating 'collectiveness'), *pe* (meaning 'all') and *lin* ('language'). It is founded on principles similar to those of Volapük, but is claimed to be more euphonious, and simpler. —— The Second Geological Survey of Pennsylvania has just published the second part of the 'Atlas of the Eastern Middle Anthracite Field.' This part contains eight sheets relating to portions of the Lehigh basins in Luzerne, Carbon, and Schuylkill Counties. The cross-sections contained in this part form portions of a series begun in the first part, and to be continued in a third instalment.

— From a reading of Darwin's biography, an Englishman has compiled the following list of authors and books which Darwin mentions as having given him the most pleasure and stimulus: Thompson's 'Seasons,' Byron, Scott, Shakspeare, 'The Wonders of the World,' White's 'Selborne,' Reynold's 'Discourses,' Humboldt's 'Personal Narrative,' Herschel's 'Introduction to the Study of Natural Philosophy,' Wordsworth, Coleridge, Milton's 'Paradise Lost,' Gray, Shelley, Scott's novels, Miss Austen, Mrs. Gaskell, George Eliot's 'Silas Marner,' and Tennyson's 'Enoch Arden.' It was White's 'Selborne' that first set him to watch the habits of birds, and Humboldt and Herschel who first "stirred up in me a burning zeal to add even the most humble contribution to the noble structure of natural science."

— The importance of the study of dialects and mixed languages is well appreciated nowadays, and essays on these subjects are fortunately becoming more numerous. The Canadian Institute of Toronto is paying considerable attention to the French dialect of Canada, as its recent numbers show; and studies of the Negro French of Louisiana have been published in the *Journal of American Folk-Lore*. The tenth bulletin of the Portuguese Geographical Society contains a very interesting study of this character, — a grammar and vocabulary of the Portuguese dialect of the Cape Verde Islands, by A. de Paulo Brito, edited by the well-known student of the Romance languages, A. Coelho. One of the most interesting features of this study is a list of proverbs, conundrums, and songs. Among the latter we mention the 'batuque,' a series of improvised songs sung at certain entertainments. A group of young men and women form a circle around a fiddler, beating time by clapping their hands, singing at the same time. Suddenly one of the group improvises a verse, which he or she sings, joined later on by the chorus. It is a matter of congratulation that studies of this character become more numerous, as the levelling influence of civilization sweeps away the remains of ancient lore and ancient customs.

— The Clarendon Press has added to its list of valuable books 'A Class Book of Elementary Chemistry,' by W. W. Fisher. The author has attempted nothing especially novel in the scheme of his book, but has given as briefly as possible some account of the most important chemical phenomena, actions, and changes, with the laws of chemical combination and the theoretical explanations of those laws commonly accepted. The book will prove a valuable text-book for high school or college.

— The fourth part of J. Macoun's 'Catalogue of Canadian Plants' has just been issued by the Geological and Natural History Survey of Canada. It forms the first part of the second volume of this valuable work, and contains the *Endogens*. The foregoing parts were issued in 1883, 1884, and 1886 respectively, and include the *Polypetalæ*, *Gamopetalæ*, *Apetalæ*, and *Gymnosperms*. Since the publication of the third part, extensive collections have been made by James M. Macoun on the shores and islands of James Bay, by the author on Vancouver Island, and by Dr. G. M. Dawson on the upper Yukon on his great expedition. That part of this additional information which is applicable to the *Endogens* is included in the present part. The work will be completed by two further parts treating the cryptogamous plants.

— C. Wellman Parks, Rensselaer Polytechnic Institute, Troy, N.Y., has undertaken the preparation of an exhibit of American periodicals for the Paris Exposition of 1889, and requests help to make it complete. He will provide wall space for copies of the various publications and group photographs of the editorial staffs, and tables and chairs for the use of those who care to examine the periodicals. Publishers are requested to send their publications to him in Paris as soon as issued, that the latest possible number may always be on file.

LETTERS TO THE EDITOR.

⁂Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Pseudo-scientific Humbuggery.

THE more mysterious a thing is, the more do ignorant people think they know about it. The learned man alone recognizes the limitations of his knowledge. On our maps the thoroughly explored regions have strict boundaries: only the *terræ incognitæ* shade off into infinity.

Now, of all the uncertain subjects at present passing under scientific scrutiny, the etiology of infectious and contagious diseases is probably the most occult; but, for this very reason, it offers irresistible attraction to all sorts of rash theorizers. At the same time, the excitement occasioned by the visit of an awful plague, like yellow-fever, discloses a ready soil of credulity for the reception of every wild dogma, and starts into life the germs of superstition everywhere lying dormant in men's mental substratum.

If you care to see how charlatans take advantage of such a concatenation of circumstances, you have only to walk through upper Broadway, and drop in at the headquarters of a certain 'microbe-killer,' which you will have no difficulty in finding. Even if the proprietor's explanation of his wonderful invention does not strike you as being altogether lucid and ingenuous, you will surely be impressed with his apparent knowledge of and faith in human nature, as shown in the certainty with which he reckons upon a paying market for his extraordinary nostrum. This is evinced also by the fact of his occupying a conspicuous place of business, for which I suppose he has paid a good rent, and, perhaps even more indisputably, by his having risked the expense of a two-column advertisement in one of the daily papers a few weeks ago. The astonishing effrontery of that advertisement is manifested, not only in the ingenious nonsense put forth as a history of the alleged discovery, but also in the impressive pictures with which the highly imaginative article is adorned. These profess to be likenesses of the "deadly microbes" for which the infallible "killer" has been providentially provided. Of course, there is not a microbe among them. They are, however, with one exception, rude reproductions of photographs of diatom valves. The exception is a representation of a part of the tracheal system of a butterfly or moth.

This use of diatoms as catch-penny wonder-workers is nothing new. Some years ago, an enterprising genius conceived the brilliant idea, that, if wheat or any other cereal were fed with diatomaceous earth, the plant would take up the siliceous shells bodily and build them into its cuticle with great economy of energy. Accordingly he "invented" a fertilizer, which was extensively advertised, both here and in Europe; and into his advertisements he too introduced drawings. These claimed to show diatoms, not as they existed in his fossiliferous fertilizer, but as they were said to have been obtained from the cuticle of straw by the disintegrating action of nitric acid. But in his illustrative plate he was so indiscreet as to figure not only siliceous diatom-valves, which would withstand the power of acid, but also a certain entire diatom in a form in which it could exist only in a living state, with its soft and perishable envelope in place; and to these he had added sponge-spicules

and other objects not diatomaceous, and even a calcareous foraminifer. Nothwithstanding these little discrepancies, the fertilizer received gratuitous indorsement from several of the leading scientific journals of England and America. In one of the latter a college professor gave it a splendid "send-off" in an article of very learned appearance, entitled 'Silica of Grasses and other Plants carried up as Diatoms or other Siliceous Grains, and not in Solution or as Soluble Silicates,' which was accompanied by the paradoxical plate above referred to.

In the cases I have mentioned, both the wholly uninformed masses and the broadly educated few were confidently calculated upon as easy victims to fraud when the recognition of some of the commonest of microscopic forms was involved. Diatoms exist on every hand, and, in both the living and the fossil state, are among the most plentiful of organisms; their indestructible remains constituting strata from three to thirty feet thick, extending through several of our seaboard States, while any Croton-water faucet will, in a moment or two, furnish abundance of living specimens of wonderful interest and attractiveness. Besides this, they have a considerable commercial importance, at least one New York firm making a trade specialty of the diatomaceous earths and the silicates made from them. And yet only a few weeks ago one of our daily journals devoted valuable space to sarcastic editorial comment on the examination papers used in the College of the City of New York, because they contained the supposed impractical and nonsensical question, "What is a diatom?" It now seems that it would be money in the pockets of some poor invalids if they only knew the difference between a diatom and a microbe.

It is the greatest shame of these impositions under the guise of science that professional men of some reputation at times lend them their countenance and aid. And, even when the thing recommended is not itself fraudulent, the mode of indorsing it often becomes so. An example of this came under my notice not long ago, when, in looking over a newspaper, my eye was caught by the word 'microscopical' occurring in a rather prominent advertisement of a certain soap, and upon examination I found that a gentleman of scientific claims had undertaken to give a certificate to the merits of the article advertised. Now, soap seems to be a thing about which comparatively little can be said from a sanitary point of view, except that a free use of it is desirable. But in the testimonial of which I am speaking there was manifested a wide-awake disposition to make the most of the passing public interest in infection and contagion. With remarkably lame logic, the scientific attorney of the manufacturer declared, in substance, that, having submitted the soap to microscopical examination, and having found it free from disease-germs, he was prepared to recommend it for its detergent qualities.

While we do not wonder to see a Wiggins rush forward, upon the very slightest excuse, as he did but lately, with a sixteenth-century astrological theory of yellow-fever, we cannot but feel both astonishment and mortification when a good chemist publicly dispenses bad microscopy, or an eminent physicist plunges headlong nto hygiene and therapeutics, as one did the other day. A man may have almost superhuman insight as to the laws of electricity and yet be as ignorant as the rest of us about the how and why of a bacillus or a spirillum. It was not very strange that a gentleman hitherto absorbed in physics and mechanics should prove to be uninformed as to the unsuccessful endeavors that had been made to isolate and identify the microbe of yellow-fever, for he had come across-lots into a scientific region of which the literature and even the language was unfamiliar to him. For the same reason, how was he to know that what would kill an ant would not necessarily kill a bacterium or a vibrio?

The trouble is, that a large part of the people who are most ready to discuss the new phase of biological science have not the faintest idea of what a microbe is. Most of them seem to fancy that merely a new name has been invented for what used to be called a spore or a germ; and of course every one knows what a germ is, for he has only to look at the seed of any well-known plant! This seems to be the difficulty with a famous military commander who has recently taken up the weapon more powerful than the sword, and, by means of it, given to the world, through one of our magazines, his *a priori* exposition of the mode of origin and spread of epidemic diseases. He may fairly claim experience in keeping yellow-fever out of a community, but, after reading his article, we may well doubt whether he really has much information as to how it gets in.

In short, pseudo-scientific humbuggery is very prevalent just now; but I suppose we may console ourselves by regarding it as a popular tribute to the worth of true science, since we are told that "hypocrisy is a sort of homage that vice pays to virtue."

CHARLES F. COX.

New York, Nov. 20.

New York Archæology.

THE Bureau of Ethnology has been doing some work in western and central New York, the results of which will soon appear; but researches quite as important and exhaustive have long been going on without public aid. If the State, or individuals in it, would take the lively interest in preserving accounts of its perishing antiquities that is shown in other things, valuable results would be certain to follow. In carrying on my own investigations, I have been surprised to see how many are working in various places on similar lines, and in the way of comparison these quiet seekers have helped me much.

The leading feature in all this is the connection of relics with sites. All use maps; and on these all local sites are indicated, and a record is made of their extent and character. All articles are numbered or labelled with reference to these sites, so that the cabinet generally shows whence the relic came. This is not always possible, but in most cases it can be done. A good antiquarian who has thrown unexpected light on one group of sites has but one arm, and yet makes drawings of the more interesting forms. I draw and describe all in my own collection, and obtain figures of large numbers of those in others. Without such a comparison, I could not have arrived at some sound conclusions.

In all these cases precision has been aimed at, and the general agreement is the more surprising when we find there has been no consultation in the matter. A large county map or atlas is used for the sites, when it can be had; and this allows of an exact record of the town, lot, farm, and even part of a farm, when desired. In making records, however, the Smithsonian code of signs is almost useless in New York, and is very little employed. The historical societies aid a good deal in the preservation of relics, but there is less aid to the scientist from their collections than might be expected. A few articles are labelled in a general way, sometimes very oddly; but care is seldom taken to connect them with the sites from which they came. Their value would often be tenfold greater were this done. It should therefore be urged upon all societies and individuals to make records of sites and relics in this way.

For scientific purposes there is frequently a deficiency in the collection of the ruder articles, as flat sinkers, chipped celts, grooved and hammer stones, but in a number of instances care has been taken of these also. Some of these are still in use in New York. It is well known, however, that some common articles in other parts of the land are very uncommon here. This is the case with the grooved axes; and the absence of early small wampum west of the Hudson River is so noticeable, that I quite agree with early writers in their statement that it was little used until the Dutch made it.

A collection of sites and relics has thrown much light on the early Indian migrations in northern and western New York, bringing out curious facts in regard to the routes chosen and the origin of the travellers or residents. It has dispelled much of the vagueness attending the occupation of the Iroquois territory, and enabled us definitely to connect historic with prehistoric times. That the facts brought out by field-workers have not always agreed with the theories of students is not surprising, but theories must always be regarded as but a temporary convenience.

In connection with this, I may call attention to a branch of ethnology which needs speedy attention, and has already received some. New York embraces within its limits a portion of the noted Six Nations, who still preserve some of their old customs, ornaments, and implements; but all who frequently visit their reservations are aware how rapidly the old is giving place to the new. To gather up the fragments is all that we can now do. Whoever un-

dertakes this work must remember, that, while all had much in common, these nations had an independent character, and that their laws, clans, feasts, traditions, and language varied greatly. Morgan's valuable 'League of the Iroquois' was a good account of the modern Senecas. Any one would be misled in applying it strictly to the Onondagas. Each nation, therefore, is worthy of independent study. If some competent person, conveniently near, would undertake this for each reservation, the results would be of great value. W. M. BEAUCHAMP.

Baldwinsville, N.Y., Nov. 12.

Species and Subspecies: A Reply to Mr. Conn.

IN *Science* of May 25, 1888 (pp. 253, 254), Mr. H. W. Conn reiterates a belief, held in common by Romanes and himself, that there is a fundamental difference between what he calls 'varieties' and 'species.' The term 'variety' is objectionable on the ground that it is susceptible of several meanings, and consequently may be understood differently by different persons. It may be assumed that the word is used by Mr. Conn in the sense in which naturalists employ the term 'subspecies,' or 'geographical race.'

Mr. Conn says, "There is no question in biology more significant, or more difficult to answer, than what constitutes a species. Upon the answer hinges the question of evolution, and more particularly the theories of Darwin. In spite of an immense amount of discussion, no answer has ever been given to the question which is in any degree satisfactory."

The above statement demonstrates the ignorance of its author in matters well understood by those who handle species, and may be taken as an illustration of the results of the methods of teaching biology now employed in our leading schools, where systematic biology is entirely lost sight of in the effort to impress upon the student the superior importance of morphology, histology, and embryology: in other words, the student is encouraged to turn his back to the broad field of nature, and to open his eyes only to peer into the contracted field of the microscope.

Systematic naturalists — those who have to do with the interrelations of existing forms of life — do not experience the difficulty mentioned by Mr. Conn in defining "what constitutes a species," and are forced to protest against his statement that "no answer has ever been given to the question which is in any degree satisfactory."

A species is a group of individuals which resemble one another in all essential respects, varying only within certain definable limits, and which is separated from all similar groups by a well-marked hiatus. A subspecies or geographical race differs from a species in one respect only; namely, that intergrades exist connecting it with the parent stock: in other words, a subspecies is nothing more nor less than an incipient species.

Mr. Conn holds that 'varieties' are the result of variations in structure outside of the reproductive organs, while 'species' result from changes in the reproductive organs themselves. He says, "Variety and species are therefore independent, being founded on different kinds of variation." This hypothesis, it seems to me, is in its very inception a contradiction of the genius of evolution.

All forms of life inherit two tendencies, — one to reproduce exactly the characteristics of their ancestors, the other to vary therefrom. Variation is the result of one or the other of two sets of causes: namely, (1) the influence of climatic or other physiographic conditions; (2) the accidental or sporadic acquirement of a character which benefits its possessor, and hence is likely to be perpetuated, and increased from generation to generation. In order to clearly understand the laws of evolution, it is necessary to discriminate between these two kinds of variation. In variation resulting from the spontaneous acquirement of a beneficial character, the line of evolution is geographically stationary, but is ascending in time. Natural selection is the cause of this form of evolution; for the excess of individuals resulting from normal reproduction brings about a struggle for existence, and the law of "the survival of the fittest" results in the extermination of the parent form and the successive intermediate stages, so that the modified form and its ancestors are not in existence at any one period of time: in other words, the line of descent must be looked for in the history of the past, among strata containing paleontologic remains. On the other hand, evolution due to geographic position — environmental evolution — may present all intermediate stages at the same time; the extremes, which we call subspecies, being found at distances remote from the centre of distribution of the type. Hence in the study of evolution it must be constantly borne in mind that there is this essential difference between 'geographic variation' and 'variation by natural selection:' that in the one case intergrades exist, in the other case they have become extinct during the process of differentiation.

Variation often takes place in more than one direction, producing several lines of differentiation which radiate from a common centre. In such cases there will be several peripheral forms which may differ from one another more markedly than each differs from the parent or central type.

In environmental variation the intermediate forms which connect the extremes with the central type, or with one another, are termed 'intergrades,' the peripheral forms being recognized as subspecies. The term 'peripheral' is here used in a geographical sense, implying that the individuals showing the peculiarity are found at points remote from the centre of distribution of the type.

It often happens that subspecies differ from one another and from the parent stock as greatly as species themselves. It sometimes happens, also, that in the course of time the forms inhabiting the intermediate region cease to exist, in which case the peripheral forms previously known as subspecies become species at once, without waiting for any further change; the only difference between species and subspecies being, as already stated, that in one case the intergrades exist, in the other they have become extinct.

C. HART MERRIAM.

Washington, D.C., Dec. 1.

Rosenbusch's Petrography.

YOUR reviewer, in his recent notice in your columns of Mr. Iddings's admirable translation and abridgment of the first volume of Rosenbusch's 'Mikroskopische Physiographie,' seems to me to have hardly apprehended the exact aim of this work. Inasmuch as the review, while not altogether unfair in its statements, may by its general tone convey the impression to those unacquainted with petrography that they are losing in the translation many essential features of the original manual, I beg leave to give the results of my own experience in the practical use of both books for purposes of instruction in a petrographical laboratory.

Heretofore the only available manual for the use of beginners in petrography has been Rosenbusch in the original; and every teacher, even in Germany, must have felt that for this purpose the book is somewhat cumbersome. My own experience has been that the mass of detail, however advantageous and necessary to the advanced worker, caused a loss of interest to students who were beginning the subject, even when they belonged to a superior class and possessed a tolerable knowledge of German. Those who, from an intimate acquaintance with Professor Rosenbusch's treatise, realized its great value, were loath to recommend even to beginners any other guide; and yet the need has long been felt of a translation which should present all the essential features of the work in English, without the mass of detail unnecessary for those taking their first steps in petrography. This need the translator has set before himself to fill, and in my opinion he has accomplished the task in a most judicious and satisfactory manner. Since the appearance of his translation a few weeks since, I have used it in my laboratory with a success which I had begun to despair of ever attaining with the original. Nothing really essential has been omitted, while the book has been reduced to nearly half its former size. The colored plate could be of no practical use to beginners, but would have increased the price of the work very considerably.

In his own preface the translator states that he has had no expectation or desire to supplant the use of the original. No student would dare to venture upon original investigation in petrography without a knowledge of German sufficient to enable him to read with ease the work in its extended form. To advanced workers Rosenbusch will be now, as ever, a vast treasure-house of information, which no abridgment of the translation will in any way curtail. GEORGE H. WILLIAMS.

Baltimore, Nov. 30.

A Correction.

In last week's *Science*, p. 256, first column, line 40, occurs a typographical error which it may be worth while to correct. I refer to the word 'eidography,' erroneously printed 'cidography,'— a word suggested as useful in discussing surveys, and having reference solely to the surface form of the earth, its ups and downs, its hills and hollows. The words 'hypsography' and 'topography' are each used for this purpose; but the first refers rather to elevation than to form, and 'topography' has been and is used in different senses, hence its meaning is uncertain until defined by the writer using it. MARCUS BAKER.

Washington, D.C., Dec. 4.

Queries.

39. WHAT IS THE ORIGIN OF FISH IN ISOLATED PONDS? —The Peninsula of Florida contains innumerable isolated ponds varying from a few square rods to many square miles in area. Many of these are simple hollows filled with rain-water, without any connection with other waters. Some of them are on high ground, where no flood can establish temporary connection with other waters, through which fish might be admitted. The smaller ones often dry up entirely in seasons of drought, yet when filled with water they do not seem to be behind their neighbors in population. They all swarm with fish, whose origin and continued presence would seem to present an interesting question. For instance: at Orange Heights, in Eastern Alachua County, which is one of the most elevated regions of the State, as is plainly shown by the radiating streams which rise in that vicinity, there is a small pond on top of the highest elevation in all that region. I have twice known this pond to be dry, yet it now contains an abundance of small fish. How have they been preserved from destruction, and whence came the original stock? CHS. B. PALMER.

Columbus, O., Nov. 20.

40. FELSPAR, OR FELDSPAR? — Will you or some one of your numerous correspondents kindly inform me which is the more correct designation, 'felspar' or 'feldspar'? Both forms are in common use among mineralogists, and most dictionaries give both. Phillips, in his 'Elementary Mineralogy,' 1823, gives 'felspar' in the text, and in a footnote 'feldspar,' from the German *feldspath*, adding, "perhaps because found on the surface of some parts of the country." Might it not rather be derived from the German *fels*, 'a rock'? If one knew when and how it was first used, this might solve the point. J. THORBURN.

Ottawa, Can., Nov. 29.

41. THE "SUPERNUMERARY MOLAR" IN MAN.— Not many days ago there was a very excellent young dentist at work at Fort Wingate, N. Mex., and while there a white man of some thirty-five years of age presented himself to have extracted what he termed "an extra tooth" in his upper jaw. Happening in, I saw this rare anatomical structure immediately after its removal. It was a small, transversely ellipsoidal tooth, with a single, conical, peg-like fang, the tooth itself having developed at its buccal aspect a small additional cusp. This tooth was situated directly posterior to the upper wisdom tooth or last molar of the left side, and in contact with it. I am aware that this rare supernumerary molar in man is alluded to in the more extensive works upon dentistry, but I would be glad if some reader of this notice will inform me where I may find the best biological account of this structure in man, as well as its significance, and whether it has ever been observed in any of the *Simiina*. R. W. SHUFELDT.

Fort Wingate, N. Mex., Dec. 1.

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SCIENCE

FRIDAY, DECEMBER 14, 1888.

ELECTRIC PROPULSION.

NOV. 26 and Dec. 5 of the current year will be memorable dates in the history of electric propulsion; for on those days the largest and most powerful electric railway-motor yet constructed gave proof, on the Ninth Avenue line of the New York elevated railways, of its capability to do all that the steam-locomotives there in use are called upon to perform in their regular service. This motor was the Daft motor 'Benjamin Franklin,' whose plan and side-elevation illustrate this article.

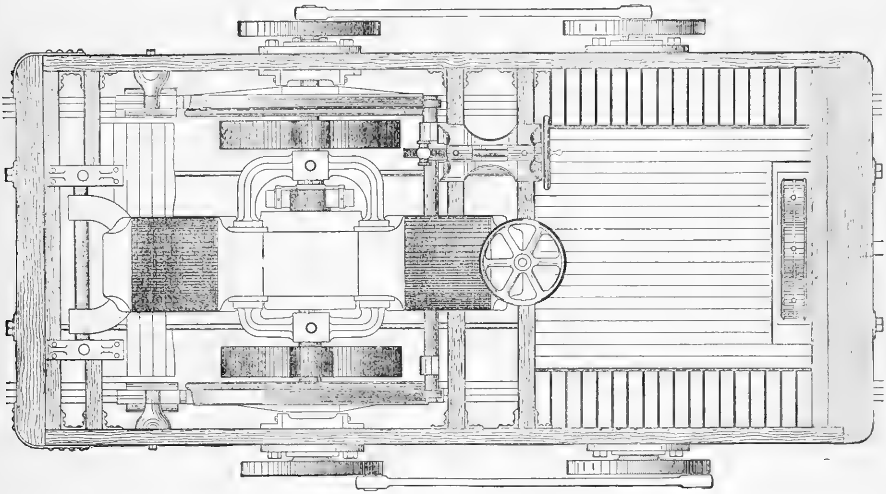
Electrical traction on a minor scale is no new thing: Siemens, at Berlin and Port Rush, had accomplished it as early as 1881, and Daft himself had achieved the first commercial success in this line — that is to say, the first electric railway ever built under a business contract, completed and paid for in accordance therewith, and continued in operation without modification thenceforward — at Baltimore in 1885; but nothing excepting the Pittsburgh motors of 35 horse-power, also of Daft's design, had passed the limit of 10 or 15 horse-power until the 'Franklin' appeared on the scene.

A general description of this motor follows; and the cuts will give a clear idea of its mechanical arrangement and details. The total weight is ten tons, — very little over half the weight of the steam-locomotives in regular use, — and the wheel-base and length over all are respectively 5′ 6″ and 14′ 6″. The total horse-power is probably 150, although there has as yet been no opportunity of making an ultimate test in this respect.

The 'Franklin' was designed to pull four cars and their seated load — a total weight of 75 tons — over any gradient of the Ninth Avenue Elevated Railway at the schedule speed of ordinary trains. In the trials a train of eight empty cars — a load of 122 tons, 47 in excess of that agreed upon — was taken up the maximum gradient (nearly two per cent) at a speed of 7½ miles per hour, and a loaded four-car train exceeded the schedule speed by almost 3 miles per hour.

The question will naturally suggest itself, 'What future has this motor, and what are its claims to preference over the system now in use on the New York elevated railways?'

The answer is, radical economy, which lies in the recognized wastefulness of small — especially locomotive — engines, and the high efficiency of large stationary engines of improved type. Multiplication of power-generators implies loss in efficiency, and increased cost of attendance. Derivation of power from one origin, with ready capability of subdivision, is economy. The average consumption of coal per horse-power, as between light rapid express and slow heavy freight-trains, is about nine pounds per hour for steam-locomotives. A modern compound condensing engine will yield a horse-power for two pounds per hour, or even less. Admitting that the conversions from power to current, and *vice versa*, consume one-third of this, it still remains that the locomotive-engine needs more than three times as much coal as the stationary for every horse-power exerted upon the track. It is demonstrable that the New York elevated railroads can be run at less than half the present cost for motive power, including a charge for interest on the cost of the new equipment, and ignoring the proceeds derivable from the sale of the old.



PLAN OF DAFT ELECTRIC MOTOR 'FRANKLIN.'

Other economical features of the system are, —

1. Reduction of attendance.

2. Conservation of permanent way from the diminution in weight of motor permitted by its superior adhesion. This is always available where the rails constitute part of the circuit, and makes plain why the 'Franklin,' of half the weight of a steam-locomotive, can haul as great a load. One of the most invaluable features of the system is the high degree of adhesion between the motor-wheels and the rails, which permits the employment of much lighter tractors than would be practicable if steam-locomotives were used, to the manifest advantage of the vehicles themselves and of the permanent way. This adhesion is not magnetic, and probably results from molecular change produced by the current in contiguous surfaces of wheel and rail. It sometimes amounts to forty per cent of the weight as opposed to twenty per cent usually observable in steam-

locomotives as the average of all conditions of track as affected by weather and use.

3. The possibility of dispensing with the complicated methods of insulation that are necessary and most expensive features of high-potential systems.

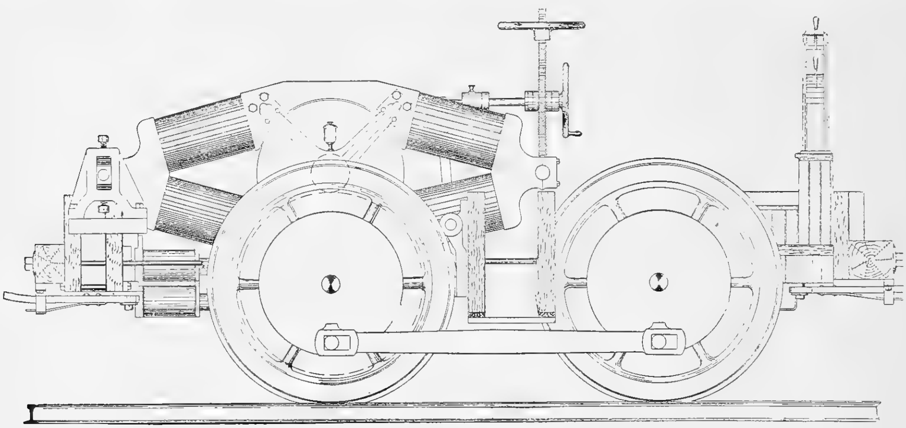
4. A potent cause of the economical working of electric railways is found in the capacity for instantaneous adjustment of the current to demands made upon it. This is so marked in the case of a double-track road with the same number of trains moving in both directions, and all deriving their power from a common generating-station, as to prompt Dr. C. A. Siemens to draw this striking analogy. He declares that two trains on the same track, one descending and the other ascending a gradient, are in as absolute connection by the current in the rails as if tied together by an actual rope. The counter-current generated by the free revolution of the dynamo of the descending train re-enforces the main current, and thus helps the ascending. The result of this is that the maximum capacity of the generating-station need only equal the average work of one motor multiplied by their total number. This will always prove sufficient. Every steam-locomotive must be ready at all times to exert its full power; and the waste of this, in the aggregate, is enormous.

familiar steam-engine, which has profited by eighty years of use, experiment, and analysis by the best human ingenuity.

To resort to generalization, the steam-engine's characteristic function is to transform heat into mechanical work; and the labor and thought of three generations have only succeeded in recovering, in the shape of work, from ten to twenty per cent of the total heat applied to it. The peculiar office of the dynamo-electric machine is the conversion of mechanical work into current electricity; and in the first decade of its useful existence it returns, in the form of electrical current, ninety per cent of the mechanical work applied to it. The adept steam-engine attains one-tenth of its possible efficiency; the tyro dynamo-electric machine, nine-tenths. "If they do these things in a green tree, what shall be done in the dry?"

ELECTRICAL POWER-DISTRIBUTION.

One of M. Victor Popp's friends was recently describing with post-prandial eloquence the wonderful system of compressed-air distribution now so extensively operated in Paris. As if it were not marvellous enough to picture to his hearers' minds pneumatic clocks throughout Paris, and all sorts of machinery deriving power from a central station for compressing air, the interesting 'diner-out' added with a most graceful gesture, "Why, messieurs, with the Popp system you freeze the dead bodies in the morgue, and you cremate them in Pere la Chaise." And thus the idea is continually forced upon one's mind that this is an age of centralization in the supply of heat, water, light, and power, and, in fine, every thing that makes life more comfortable, and business more practicable. The application of electricity to the distribution of power has been developed with comparatively more marked progress than the electric-lighting industry met with in the early stages of its existence; and this is not strange, when we consider the advantages of electric motors, and the fact that their use makes a material difference with small manufacturers in the item of cost of power, besides constituting an important feature of safety. The fact that the noisy, dusty, and dangerous steam-engines which are being used in so many printing-offices, book-binderies, and various other shops where power is needed, may be displaced by quiet-running electric motors, which are not dangerous and do not take up much room, added to the actual saving in money which is accomplished by such a change, are points which are so easy of demonstration, and commend themselves so readily to the popular mind, that the introduction of electric motors has not met with any serious obstacles. Although the first experimenters built motors before they built dynamos, it is only within the last two or three years that practical machines of a high efficiency have been offered to the public. Some of the machines now give an efficiency of over ninety per cent in the conversion of electrical into mechanical



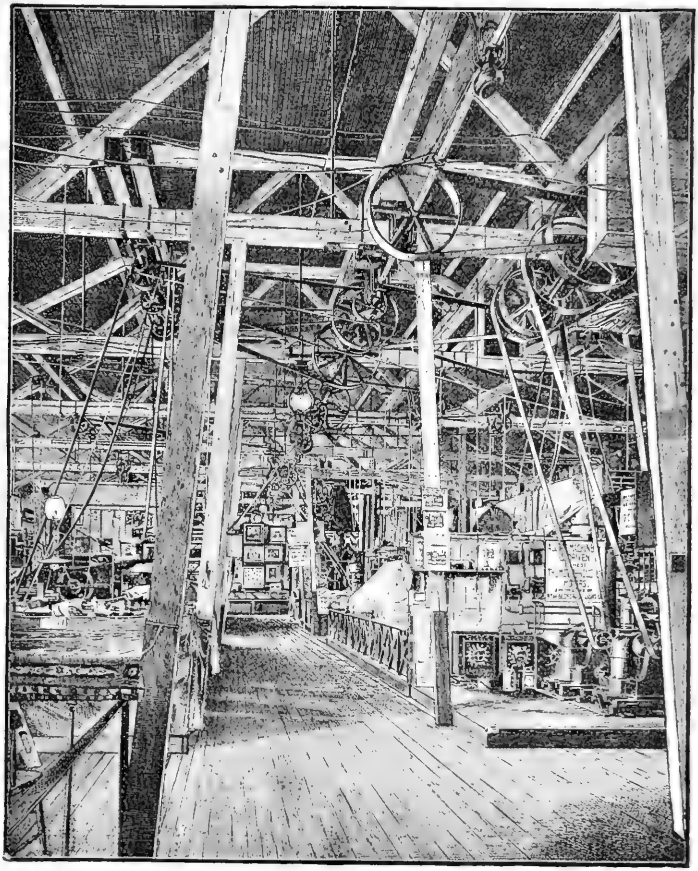
SIDE-ELEVATION OF DAFT ELECTRIC MOTOR 'FRANKLIN.'

The following facts are significant as regards electrical propulsion: 1. The production, by modern stationary engines of the highest efficiency, of a horse-power for two pounds of coal, or less, per hour; 2. A recovery, in kind, from an electric circuit of reasonable length, of at least sixty-five per cent of the mechanical power applied to it; 3. The consumption by small stationary and locomotive engines of from seven to nine pounds of coal per horse-power per hour; 4. The consequent development in the circuit of a horse-power for three pounds of coal as opposed to seven or nine; 5. A marked reduction in original and current cost of motive power, due to lessened weight, simplicity, and diminished attendance; 6. A notably lower rate of deterioration than other machinery, due to the use of low-potential currents, absence of reciprocatory motion, etc.; 7. Conservation of permanent way, arising from the lessened weight of motor due to superior natural adhesion and the power of increasing the same magnetically to any necessary degree; 8. A unique economy arising from the fact that there is no necessity of having superfluous power in reserve, — a consequence of the capacity for instantaneous adjustment of a current throughout an entire circuit to the demands made upon it.

If one may judge by comparison with other mechanisms, the future of the dynamo-electric motor is pregnant with possibilities. The measure of perfection of any machine is the degree of efficiency with which it performs its specific work. Referred to such a criterion, dynamo-electric machinery stands, at the very starting-post of its career, infinitely nearer to its theoretical ultimate than the

energy; and it is plain that there is no possibility of very much improvement in the efficiency of conversion. The regulation of the electric motor is accomplished in some cases by artificial means; but in the most approved type of electric motors the regulation is in the machine itself, and depends upon an electrical principle as interesting and wonderful as any fact in the whole range of the science. Comparatively speaking, it is this. Dynamos and motors are interchangeable: when we put mechanical power to the machine, and make thereby electrical power for further use, we call the apparatus a dynamo-electric machine; if we reverse the process, however, and bring forth mechanical power by putting a current of electricity through a machine, it becomes an electric motor. Every motor, while receiving the electric current and doing mechanical work, is at the same time retaining to some degree its character as a dynamo-machine; for it is generating a current directly in opposition to the current which causes it to run. This opposing current serves as a resistance to the current supplied to the motor, and varies with the speed of the motor.

Now, in the Thomson-Houston motor, which is here illustrated, if the speed has a tendency to slacken, this opposing current necessarily becomes less, and thus admits to the motor more of the supply-current, which, in its turn, brings back the speed of the motor to its normal speed. The working-power of the motor increases as the square of the current, so that a slight increase in the current (due to the momentary slackening of the speed) is sufficient to make the motor take up its increased load. The change in the electrical condition is practically instantaneous, so that no change in the speed of the motor is perceptible within the moderate changes in the work which it is doing. With a maximum change in the load which the motor is carrying, the variation of the speed of the motor is within two per cent of its normal speed. Such close regulation, it is needless to say, is all that can be desired in any machine. The motors of the Thomson-Houston Electric Company, like all the other apparatus of that system, have been widely introduced, and are in use in many printing-offices, machine-shops, and small factories. They are made in sizes to furnish from one-half to seventy-five horse-power. The larger sizes are, of course, especially valuable for the transmission of power from waterfalls whose distance unfits their utilization by the old methods. Factories may be placed some distance from the water-supply, and get power over the wires.



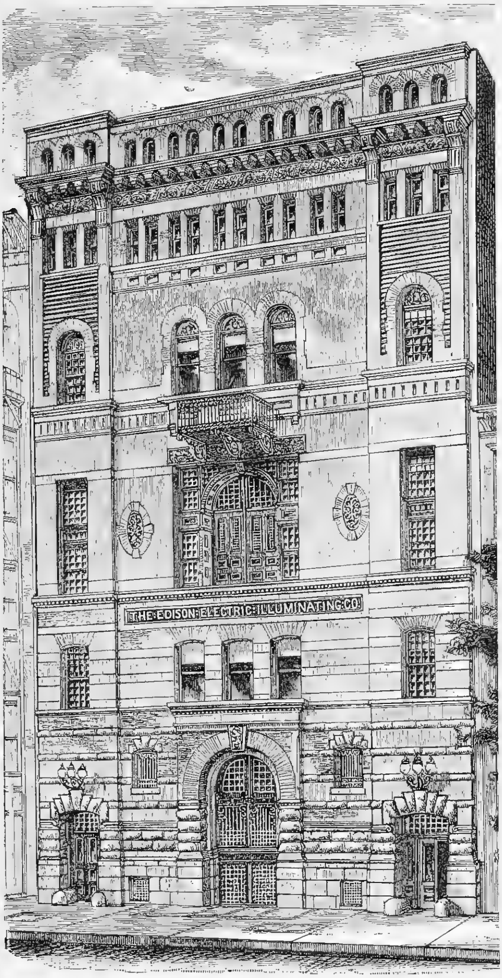
THOMSON-HOUSTON MOTORS IN THE BOARD OF TRADE EXHIBITION, NEW BEDFORD, MASS.

In addition to the stationary motor, the Thomson-Houston Company have developed extensively those applicable to electric street-cars, having in operation twenty-three electric roads, and eleven in process of construction.

The accompanying illustration represents two Thomson-Houston motors in the exhibition of the Board of Trade at New Bedford, Mass. These motors are supplied by current from the central electric-lighting station of the New Bedford Gas Company, and are furnishing to the shafting all the power required in the various exhibits at this fair.

THE EDISON LIGHT FOR HOUSES, STORES, THEATRES, ETC.

THERE is probably no new industry of equal magnitude that is comparatively so little known to the general public, even in this city, as that of supplying the Edison incandescent light from central stations for interior illumination. Six years ago a small station was started at 255 and 257 Pearl Street. This station has been running continuously, night and day, since Sept. 4, 1882, and is now supplying some 15,000 lamps through a network of 56 miles



NEW EDISON CENTRAL STATION, W. 26TH STREET, NEW YORK.

of underground conductors. It was freely predicted that mechanical and electrical difficulties would constitute a barrier to its success; but, these apparently insurmountable obstacles having been overcome by the indomitable perseverance and peerless skill of Mr. Edison, the next prognostication was financial failure. In spite of these dire forebodings, the enterprise was long ago established upon a successful paying commercial basis, as a result of which the capitalists who were pioneers in the business have recently supplied the capital with which to construct two immense stations for supplying residences, stores, theatres, hotels, etc., in the upper portion of the city.

About 165 miles of conductors were laid under ground, covering a district from 18th to 59th Streets, and from Sixth to Fourth Avenues; and two substantial buildings were erected, — one on 39th Street, near Broadway; and one on 26th Street, near Sixth Avenue. These stations are about completed, and ready to furnish lights, and will have an ultimate capacity of 50,000 lamps each. This great luxury, so long enjoyed by many business-men in their down-town offices, will now be within reach of their uptown homes, and our citizens will welcome a light which does not heat or vitiate the atmosphere by burning up the oxygen; does not destroy or deteriorate decorations, pictures, books, etc.; obviates risk of fire; is as conducive to the preservation of eyesight as the natural light of the sun; and is capable of innumerable applications for ornamental and decorative purposes, as well as for the supplying of power for pumps, elevators, ventilating-fans, sewing-machines. For these and many other purposes the electric current will be ever present, night and day, and will be furnished and charged for by a meter the accuracy of which has been proved by six years of practical use, and at prices that will place one of the greatest luxuries of modern times within reach of all.

HADFIELD'S MANGANESE STEEL.[1]

THE most notable contribution to the metallurgy of manganese and its alloys made in recent years is the paper read before the Institution of Civil Engineers of Great Britain by Mr. Robert A. Hadfield, of Hadfield's Steel Foundry Company, Sheffield, on Manganese steel, the invention of his father, but which the author of the paper has done so much to perfect. This steel has been described in previous reports, but Mr. Hadfield's paper sets forth so clearly some of the very peculiar properties that manganese in large quantities imparts to steel, that, with his permission, we quote from it at considerable length.

The most noticeable characteristics of the Hadfield manganese steel are its peculiar hardness, combined with great toughness, the effect of water-quenching upon the steel, and its electrical properties.

Peculiar Hardness.

It is difficult to accurately describe its peculiar hardness, because all the specimens are exceedingly hard; in fact, it is scarcely possible to machine any of them on a practical scale, yet such hardness varies considerably in degree, being most intense in the cast material, containing 5 to 6 per cent manganese, which no tool will face or touch. A gradual decrease is noted then, and, when about 10 per cent is reached, the softest condition occurs. Then an increase again takes place, and at 22 per cent it is very hard, still not so much so as in the 5 per cent. After passing 22 per cent, the cause of hardness becomes more complicated, owing to the presence of more carbon, 2 per cent and upwards; in fact, the material begins to partake more of the nature of cast iron, though as to strength, when compared with the latter, specimen No. 225 (carbon, 2 per cent; manganese, 23.5 per cent) had a transverse strength of 34 tons against 10 tons for cast iron.

The 8 to 20 per cent material can be machined, although only with the utmost difficulty, as will be seen from the following example. The test-bar No. 22 B (manganese, 14 per cent), which elongated 44.5 per cent without fracture and had a tensile strength of 67 tons, was put under a double-geared 18-inch drill. Over an hour was occupied in drilling one hole one half-inch in diameter by three-fourths inch deep; and even to do this it was requisite to run at the lowest speed, or the edge of the drill would have given way. During this time fifteen to twenty holes of the same size could have been easily drilled in mild steel. Similar results from specimens sent to different engineering firms in Sheffield and elsewhere confirm this test, yet this specimen could be indented by an ordinary hand-hammer; so that, whilst so hard, it may be said to possess "a special kind of softness." Although, when being turned, it appears harder than chilled iron, its softness is particularly noticeable when testing the material for compression. Specimens of 10-per-cent manganese steel 1 inch long by .79 inch in diameter,

[1] Extract from a paper on 'Manganese,' by Joseph D. Weeks, to appear in the forthcoming volume of 'Mineral Resources of the United States,' published by the United States Geological Survey, edited by Dr. W. T. Day.

notwithstanding they require several days' preparation in the lathe, owing to their hardness, yet, under a compression load of 100 tons per square inch, shorten .25 inch, and the harder kind (manganese, 15 to 20 per cent) .1 inch to .13 inch. Chilled iron or hardened steel would stand this test without any alteration. A cast specimen, No. 24 B (manganese, 14.75 per cent), not forged, made into a standard Whitworth test-piece, took nearly a fortnight to tool and finish.

The test-bar of the specimen (12.75 per cent) tested by Mr. Wellman, of the Otis Iron and Steel Company, Cleveland, O., was a day and a half in the lathe, as against half an hour for ordinary mild steel.

Owing to this peculiar hardness, its general application to castings has been limited by the difficulty of machining them, no method having yet been perfected by which the heads or runners can be cut off, or the castings otherwise tooled to shape. Tool steels from the best makers have been tried, including self-hardening kinds and tools made of manganese steel, but without success. The tests and applications, therefore, have necessarily been confined to castings, where the runners could be broken off cold or pared off hot.

Water-Quenching, and the Effect of Heat upon Manganese Steel.

Naturally one of the questions asked, when examining a new material said to be steel, or possessing the properties of steel, is, 'What effect has water or other cooling medium on it when plunged therein in a heated condition; in other words, will it harden?' Again: the behavior was found to be quite different when compared with ordinary carbon steel, no hardening action taking place. Water certainly causes the material to become stiffer, but in an entirely different degree to hardened carbon steel; for a piece of manganese steel, after such treatment, is slightly more easily touched by a file: therefore, for the following reasons, the process now described is termed 'water-toughening.' The increase in stiffness is most marked, the tensile strength rising from 40 to 60, and in some cases over 70, tons per square inch; but this is not a mere stiffening or hardening effect in the ordinary sense of the term, for in all carbon steel such rise is invariably accompanied, when the cooling medium is water, by a considerable decrease in the ductility or elongation, whereas in this material just the opposite effect is produced. In specimens Nos. 22 B and D^2 the tensile strength of the bar as received from the forge was only 36 tons per square inch, with 1.56 per cent elongation. This latter is exceptionally low, usually being 6 to 8 per cent. After water-toughening, it rose to the extraordinary amount of 67 tons, with 44.44 per cent elongation; and even then the specimen was not fractured, as at this point it was considered worthy of being retained unbroken. The same result occurs if the piece under treatment be dipped when at a welding heat, though the carbon be as high as 1 per cent or more. With regard to those samples containing below about 7 per cent manganese, this treatment seems to exercise little or no influence, and the material is comparatively valueless where toughness is requisite. While touching upon this point, the results obtained by the Terre Noire Company of France with high manganese steel (1.75 to 2.25 per cent) should be referred to. It is stated that it was not possible to obtain test-bars when dipped in water or oil, as they either cracked or broke into pieces. Strange to say, not a single bar in these experiments has behaved so. Take, for example, No. 4 B, with 6.95 per cent of manganese, which may be termed comparatively low, and more approaching to the Terre Noire material: the test-bar, when heated to a white heat, could be safely plunged into either water or oil without being water-cracked.

After a large number of tests with regard to the action of heat and sudden cooling upon this material, generally speaking, it has been found that the higher the heat of the piece treated, and the more sudden and rapid the cooling, the higher will be the breaking load, and the greater the toughness or elongation. Six of the bars were heated as uniformly as possible to a yellow heat, and plunged into water of 72° F. These gave breaking loads varying from 57 to 63 tons per square inch, and elongations of 39.8 per cent to 50 per cent. As a comparative test, another test-bar of the same material, heated in precisely the same way and to the same degree, but plunged into water at a temperature of 202° F., gave only 53 tons and 32.8 per cent. The more rapid cooling of the other test-bars was evidently the cause of their superiority, the chemical composition of all being the same.

It was also thought that sulphuric acid, being a rapid conductor of heat, might give good results as a cooling medium. The experiment was therefore made with a bath consisting of equal volumes of water and of sulphuric acid, and on 8 inches the extraordinary elongation of 50.7 per cent was reached with a breaking load of 65 tons, the bar being thus drawn cold $4\frac{1}{16}$ inches before fracture. Another specimen on a 4-inch length gave 56.75 per cent. The operation of merely heating the forged test-bar to a yellow heat and cooling it in air has a very beneficial effect, the elongation in most instances being increased to 15 and 20 per cent, the tensile strength also rising 8 or 10 tons per square inch.

As before pointed out, the temperature to which the bar is subjected has a marked influence. Although good tests result when the specimens are treated at lower temperatures, the best are obtained with as high a temperature as possible, the bars being thoroughly soaked, and plunged into cold water. Care, of course, must be taken that they are not burnt, or heated beyond a welding heat. In those specimens where the alloy is not so pure a mixture of iron and manganese, and the material cannot be heated so hot without crumbling, lower temperatures also give good results, viz., 40 to 46 per cent elongation. The best tests have been obtained with material containing 12 to 14 per cent of manganese, though those with 10.83 per cent are also good, considering their high breaking loads as compared with mild steel. However, special attention is drawn to the peculiar fact that an increase of 4 per cent in the manganese causes such a considerable rise, both in tenacity and elongation. The cause of this is very obscure, the only explanation offered being that the peculiar crystallization in the cast ingots seems to disappear gradually after passing about 11 per cent, and the fibre noticed is not so much a cause of weakness. This is only surmise, as to the eye the fibre in even the lower percentages entirely disappears in the hammered bar.

It is not easy to understand the action of the water-quenching process. As so ably explained by Chernoff, the effect of oil-tempering on ordinary steel is to produce a metal of fine grain, which possesses much greater strength than open, coarse-grained steel. If, however, forged manganese steel possesses any real difference of structure, after being heated and water-toughened, it is rather in the direction of a more open than a closer grain. But the most puzzling case in the author's experience is that of the cast-toughened 9-per-cent specimens, at which percentage, as before pointed out, the crystallization is very peculiar. An ingot $2\frac{1}{2}$ inches square and 2 feet long was cast in an iron mould. When cold, a piece was broken off, requiring four blows under a steam-hammer. The fracture showed the usual peculiar form of the 9-per-cent material, — a form which, to outward appearance, is unchanged by any heats short of the actual melting-point. The other piece was reheated to a yellow heat, and water-quenched. In this the toughness was increased in a remarkable manner, ten blows of the steam-hammer being required to break the bar. The appearance of fracture was unchanged. What caused the increase of toughness? In this case, certainly, it was not owing to structural changes, the pronounced form of ingot not being to the eye in any way altered. It will therefore be understood how difficult it is to offer any satisfactory explanation of these peculiarities.

Considering the effects of water-toughening, special attention is drawn to a specimen containing, carbon, 1.85 per cent; manganese, 9.42 per cent. Ordinary steel with this amount of carbon would be excessively hard if water-quenched even at a dull-red heat; in fact, it is questionable whether it could be hardened at all without being water-cracked. Yet the above specimen was heated to a high heat, plunged into cold water, and the bar was not water-cracked, and, if changed at all, slightly softer. Carbon seems, therefore, entirely deprived of its usual hardening properties, and it is probable that manganese must be partly considered as the cause of the high tensile strength of this material, that is, unless iron itself possesses the property of taking some other form not hitherto suspected. Further, iron so combined with manganese is rendered capable of elongating 50 per cent on 8 inches, against about 30 per cent in

the best brands of wrought iron, which contain about 99.5 per cent of iron, against 84 per cent in the manganese steel.

Electrical Properties.

This material possesses the peculiar property of being almost entirely non-magnetic. Rinman mentioned in 1773 that manganese diminishes, and in the end destroys, the magnetic properties of iron. This was also noticed in some specimens of manganese alloys made by Mr. David Mushet about 1830. This is especially curious, seeing that iron is present in amounts eight or nine times greater than the manganese itself. An approximate idea of the amount of manganese contained in the steel may be formed by passing a magnet over specimens. As the percentage of manganese increases, the magnet's power decreases. Upon reaching about 8 per cent, there is no attraction in the bulk, though fine drillings are influenced; but even this diminishes, as, when 20 per cent is reached, a magnet capable of lifting 30 pounds of ordinary steel or iron will only lift pieces weighing a few milligrams. On this point the material behaves in the same manner either in its forged or cast state, water or oil quenching making practically no difference.

Some interesting experiments with regard to the physical properties of manganese steel have been made by Sir William Thomson, Mr. Bottomley of Glasgow, and Professor Reinold of the Royal Naval College, Greenwich. Prof. W. F. Barrett, of the Royal College of Science, Dublin, has also experimented respecting its non-magnetic character and electrical properties. His experiments were carried out upon a sample containing, carbon, .85 per cent; manganese, 13.75 per cent; the wire being drawn to No. 19 British wire gauge. The author first attempted to draw direct from the rods, but with little progress; the wire, owing to its hardness, breaking into short lengths when being pulled through the wortles. Ordinary annealing was tried, but with no better results. As exceedingly good bending tests have been obtained with bars from the same steel, when heated to a yellow heat and plunged into cold water, the rods were treated in the same manner. These were coiled up, heated to whiteness, and plunged into cold water. The material was then easily drawn; but, after every reduction through two sizes, its ductility was again lost, and the operation of heating to whiteness and quenching in cold water was again necessary. A specimen has been subjected to white heat no less than five times, and is yet uninjured, as will be seen from the remarkable tensile tests obtained from it by Professor Barrett, viz., 110 tons per square inch, in its hard state. A similar result was obtained by the manager of the wire department at the Barrow Steel Works, the report being "that it would stand any tensile load up to 100 tons per square inch, according to the temper, and the elongation was extraordinary." The density, according to Professor Barrett, was 7.81, which is somewhat lower compared with the specific gravity obtained at the Hecla laboratory; viz., 7.83 on the same wire. The electric conductivity was found to be very low; No. 19 British wire gauge wire, .96 millimetre in diameter, having a resistance of 1.112 legal ohms per metre, or 75 microhms per cubic centimetre at 15° C. Ordinary iron wire is only 9,800, and German-silver 21,170; so that use might be made of the manganese steel for resistance-coils in electric-lighting. This has since been successfully applied by Dr. E. Hopkinson, in Messrs. Mather & Platt's electric department. Its high specific resistance, and capacity to stand heating, make it very useful for resistance-boxes. A length of 1,180 yards No. 8 British wire gauge (No. 634, manganese 13.95 per cent) was cut into three lengths, coupled parallel, the conductor consisting of three strands No. 8, then coiled into a box 3 feet by 2 feet by 2 feet, and gave a resistance of 6.5 ohms, carrying 80 ampères without over-heating. It was therefore capable of absorbing 55-horse power. To produce the same resistance with iron wire, 5,000 to 8,000 yards would be required, or, of expensive German-silver wire, 4,780 yards. Professor Barrett also finds that its increase when heated is only .136 per cent for each degree carbon, as against iron .5 per cent.

In the same way it is a bad conductor of heat. A rough test was made at the Hecla works by putting a bar of this material and one of ordinary wrought iron into a smith's fire. The latter became too hot to handle in about half the time required for the former. From this will be seen the importance of thoroughly 'soaking' this steel when forging it, or the outside only may be heated.

As regards its non-magnetic properties, a small piece of the No. 552 wire was not attracted in the slightest degree by the most powerful electro-magnet capable of lifting a ton; but, suspended by a thread, it behaved like a paramagnetic body. Professor Reinold found that the water-quenched or softened wire acquired slightly more permanent magnetism, but that with both a most sensitive galvanometer-needle was required to show that the material was not copper or other non-magnetic body. The exact amount was determined by Professor Barrett after most careful experiments. In comparing this with ordinary steel, he states that it was like weighing hundredweights and grains on the same balance. The magnetism of ordinary iron being represented by the figure 100,000, manganese steel is 20, and its susceptibility, i.e., the induced magnetization, is about as low as zinc or other non-magnetic metal. It is somewhat extraordinary to find no sensible attraction exerted on this steel by the most powerful magnetic field that could be obtained, this agreeing with Dr. Hopkinson's experiments. If other difficulties can be overcome, this peculiar quality should make it suitable for dynamo bed-plates. Ships built of such steel would have no sensible deviation of the compass. Magnetic influence, while not affecting this material, passes through it, so that a needle placed upon a flat sheet of manganese steel can be readily moved by a magnet placed underneath. The same thing occurs if brass or sheet copper be substituted, but not with ordinary steel or iron.

Further interesting experiments have also been lately made (September, 1887) by Profs. J. A. Ewing and William Low. The former concludes his experiments by stating, that, even under magnetic forces extending to 10,000 C.G.S. units, the resistance which this manganese steel offers to being magnetized suffers no change in any way comparable to that which occurs in wrought iron, cast iron, or ordinary steel, at a very early stage in the magnetizing process. On the contrary, the permeability is approximately constant under large and small forces, and may be therefore concluded as being only fractionally greater than that of copper, brass, or air.

MUSICAL BOXES.

MUSIC, both as a science and an art, has reached a stage of development so far advanced that further improvement in any department must necessarily seem slow and insignificant. Yet improvements are being made in many directions, seemingly small, but really great enough to demand more than a passing notice.

A good instrument is, of course, necessary to the production of

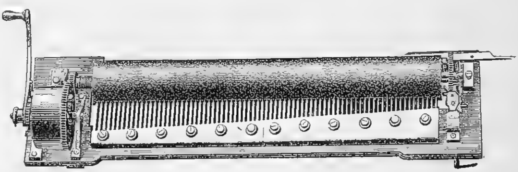


FIG. 1.

good music; but upon even the best of such instruments as the violin or piano, for instance, good music cannot be produced without the aid of a good musician. Of musicians, as musicians go, there are plenty, — ordinary every-day musicians, not born to the art, but bred to the business, working at music as a trade, not as an art; but of good musicians, with a heritage of genius supplemented by a lifetime of labor spent in study, there are few.

Most people are lovers of good music, or at least of melodious and harmonious sounds. Among these are many who are not musicians themselves, and by whom the services of a good musician are not at all times procurable, nor perhaps desirable. There is but one among the innumerable instruments in vogue to-day to which such persons can turn, — an instrument in which more or less successful attempts have been made to combine not only the parts to be played upon, perfect of their kind, but also as close an approximation to the executive talents of a musician as mechanical skill will give. This instrument is known as the musical box, not the crude mechanism of a few decades ago, but the improved instrument of to-day.

Musical boxes, properly so called, were invented about the beginning of the present century, and were at first exceedingly imperfect and costly. Since that time numberless improvements have been made, notably by members of the Paillard family, of Ste.

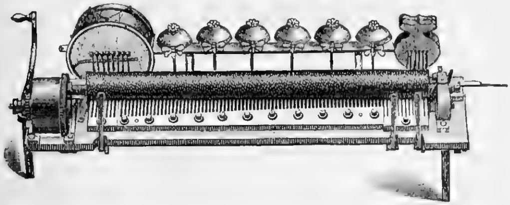


FIG. 2.

Croix, Switzerland, at which place they have been engaged in the manufacture of these instruments since 1814. Many of the musical boxes, as now made by this house and exhibited in New York, have attachments which bring into play various devices, such as bells, drums, and castanets, for adding to the general effect. There are also what are known as the 'mandoline or tremolo harp-zither' attachment, 'sublime harmonie,' 'zither harmonique piccolo and tremolo,' and 'orchestra.' These boxes are furnished with one, two, or four springs, and single, duplex, or interchangeable cylinders.

At Fig. 1 is shown the cylinder, comb, and spring-barrel of an ordinary musical box. The winding-lever stands at the extreme left, and the small fan-shaped governor for regulating the speed may be seen at the right. Fig. 2 shows the works of a box with drum, bells, and castanets. These attachments may be silenced separately or together. Fig. 3 shows works with thirty-minute coupled springs and mandoline or tremolo harp-zither attachment. The characteristic feature of this box is that the same note is repeated consecutively, as is done on the harp, guitar, or piano.

An instrument with coupled springs and double comb or keyboard, giving a much louder and fuller tone, is shown at Fig. 4. An improvement on the coupled springs is shown at Fig. 6. It consists of a combination of four springs, enabling the instrument

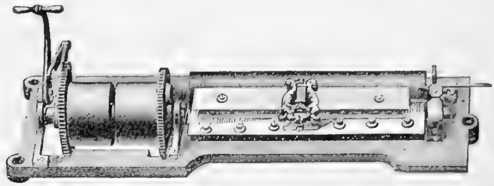


FIG. 3.

to run one or two hours with one winding. The orchestral musical box, the mechanism of which is shown at Fig. 5, has, besides the devices already mentioned, a flute or 'celestial voice' attachment, consisting of reeds placed in the centre of the keyboard, and vibrated by air from the bellows underneath the bed-plate.

One of the recent improvements in these instruments is what is called the 'interchangeable cylinder' system, the advantage of which is that additional cylinders may be obtained at any time, ready for immediate use, without the necessity of sending the box to the factory to have them fitted. This is an adaptation of the interchangeable system so much in vogue in the manufacture of sewing-machines, type-writers, and similar articles.

Few persons have any idea of the extent and importance of the

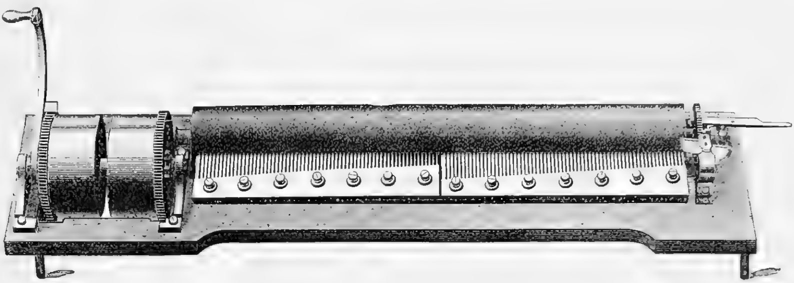


FIG. 4.

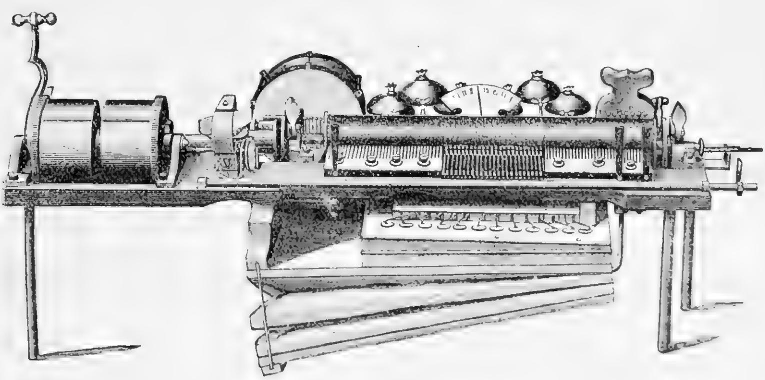


FIG. 5.

trade in musical boxes, but a visit to the establishment of M. J. Paillard will convince the most sceptical that automatic musical in-

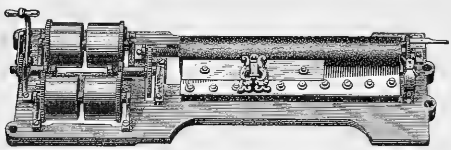


FIG. 6.

struments play an important part in satisfying the musical demands of the public.

MENTAL SCIENCE.

The Illusions of Drawing and Painting.[1]

THE arts of drawing and painting depend upon the possibility of presenting to the eye a result in two dimensions of space which it will readily transform into one of three dimensions. In this process there is a large element of illusion — of conscious, designed illusion. The chief factor in this process is perspective. If the spectator take, whether in imagination or reality, the position of the artist when making the design, the image on his retina will be the same as that on the artist's retina, and the design will be recognized as the counterpart of the reality, provided the spectator knows in general the nature of the object represented. If the facsimile is to be more exact, color must be imitated, light and shade introduced, and the retinal effect copied with all the skill of eye and hand. In order to have an æsthetic effect, the picture must represent known objects: the interpretation of two-dimensional objects into three-dimensional must be rendered easy by the knowledge of the three-dimensional. The artist must not create entirely new forms: exceptions are apparent only, and prove the rule. The poetic monsters are either conventionalized, or unite incongruous but existing forms, — half man and half beast. This is especially necessary when the object of the drawing is purely intellectual, — to make clear something not easily expressed in words, such as designs for houses, mechanical constructions, and the like. Here a more or less exact knowledge of the type of object represented is needed. To the layman such designs have little meaning.

In artistic painting, however, it is not the most detailed and exact drawing that produces the best result. Photography excels all manual art in this, but its effect is of a lower order. The same can be said of those clever productions by which a bas-relief appears drawn in two dimensions, or the objects of a panorama to stand out in three. One admires the skill, but it is a curiosity rather than a piece of art. But the object of art is not servile imitation, not to give the spectator an absolute illusion, but to arouse certain feelings, certain thoughts; and those details must be chosen that bring to mind the appropriate sentiments.

The spectator of a painting never loses entirely the sense of viewing a painted surface: for (1) the drawing is strictly accurate only for one point of view; every change of position vitiates the perspective; (2) the phenomena of binocular vision prevent the illusion (the points of the canvas are seen at the real distance of the eye from the canvas, and not at the various distances required by the perspective; while, furthermore, the real object would form different images on the two retinæ, and the painting gives two nearly alike); (3) even in viewing objects monocularly, we get impressions of distance, for the eye constantly moves, while these changes are quite different in viewing a painting with one eye (the illusion of a painting is no doubt increased by regarding it monocularly through a hollow tube); (4) color and light can be imitated, but their mental effect is recognizably different from that of the real objects.

A picture placed in a horizontal position produces the illusion nearly as well as in a vertical position. If it be a marine view, the water does not seem vertical in the former case, though in the latter it seems horizontal. If it be an architectural design, it is not displaced, any more than we confuse directions when we gaze at an object in a reclining position. This is the result of much practice in seeing the form of representations irrespective of their position, and in transforming the actual retinal image into the one that the artist intends. If you dispense with all light and shade, with all color, with all perspective, and leave simply a bare outline, then we can see in such an outline all the various designs which it can physically represent. If you draw one square within another and join the corners, you can see such a figure either as the description just given, or as the picture of a shallow trough looking into the bottom, or as a view of the same object from the bottom; and so on. Light and shade, familiarity with the design, decide what we shall see. This does not mean that the artist may neglect perspective, but only that the object of the perspective is to make easy the mental apperception of the spectator. Cases occur in which a painter violates the rules of perspective, if by following them he would produce a scientifically accurate but apparently unnatural result.

In the perception of distance the objects touching the lower edge of the canvas are, as a rule, meant to be seen as in the plane of the canvas. This gives the spectator his point of view, while the framing of the picture by supplying a vertical and a horizontal, aids very materially his conception of position. If in a landscape we have the ground touching the lower end of the canvas, and the sky the upper, we can judge distances best. If a prominent object is cut at the edge of the canvas, it increases the difficulty of distance perception. Of course, the size of the painted objects need bear no approximation to the actual size. Our eye is trained to perceive form relations independently of size; and, if the real size of the object is familiar, we involuntarily suppose a more distant point of view. So, again, we generally underestimate the size of colossal figures, because we allow too much for our distance from them.

A more complete proof that imitation is not the artist's chief aim is that he attempts to represent motion in a single view, which physically is impossible. When a tree is represented in a wind, its branches are shown bent and strained in the direction of the wind; and this gives us at once the picture of a wind, of motion. So in a figure the attitude characteristic of a series of motions stands for the motion itself. It is not so much the fidelity as the suggestiveness of the attitude that is important. So, again, when objects move very rapidly, they become indistinct to our vision, and by painting them as indistinct the illusion of rapid motion is aided. If the motion is too rapid for the eye to follow, as in the rotation of the spokes of a carriage-wheel, the peculiar appearance can be imitated on canvas, and suggests extreme speed.

In the walk or run of an animal, although one position follows another with great rapidity, the eye selects certain positions as typical, and these the artist uses as the presentation of movement. Generally the position at the beginning or the end of a step is chosen. Instantaneous photography shows the great variety of positions in passing from one step to another; but many of these have an unnatural appearance to the eye, and the artist cannot utilize them.

A very distinctive illusion is shown in many portraits in which the eyes seem to follow the eyes of the spectator. This occurs when the model's eyes are facing the artist's. We assume the position of the artist, and so have the eyes in the picture looking at ours. If we move to one side, we get the illusion of the portrait's turning about, because the eyes still suggest direct vision, and the rest of the pose does not strongly contradict it. This lateral displacement, brought about by a change of position, is very slight in a painting, while very marked in a three-dimensional object. Paintings of animals frequently show similar effects. The true artist must understand and utilize such illusions, for they make the difference between what is lifelike and what is artificial.

[1] By M. J. L. Soret, in *Revue Scientifique*, Nov. 3, 1888.

THE HOMING INSTINCT. — Dr. George M. Gould (*Progress*, October, 1888) has collected authentic cases of animals finding their way homeward over long distances. Dogs, even when carried away in a blindfolded or drugged condition, find their way home over distances from five to five hundred miles; and in one case, when the dog was taken off along the two sides of a triangle, he came home by the third side. The exquisitely trained instinct of the flying pigeon, and similar capabilities of most animals, show the

great importance of this faculty. By way of explanation, Dr. Gould suggests, that, without the faculty of finding the way homeward, the sphere of an animal's life would be very narrow. The maintenance of the species would develop the power of seeking new fields and the power to turn homewards. The ordinary senses cannot account for this homing instinct, as actual experiments have shown. Dr. Gould sees here the true sixth sense, and regards it as a sensibility to changes in electric and magnetic tension, due to position on the earth's surface. The home is the animal's north pole. By habit, it is accustomed to the magnetic conditions there, but when away is restless, and finds its way homeward by this mysterious compass. Dr. Gould connects with this some fanciful speculations as to the import of the pineal gland as a possible magnetic organ, and some hints as to the physical nature of homesickness in mankind.

ELECTRICAL NEWS.

A Novel Telephone.

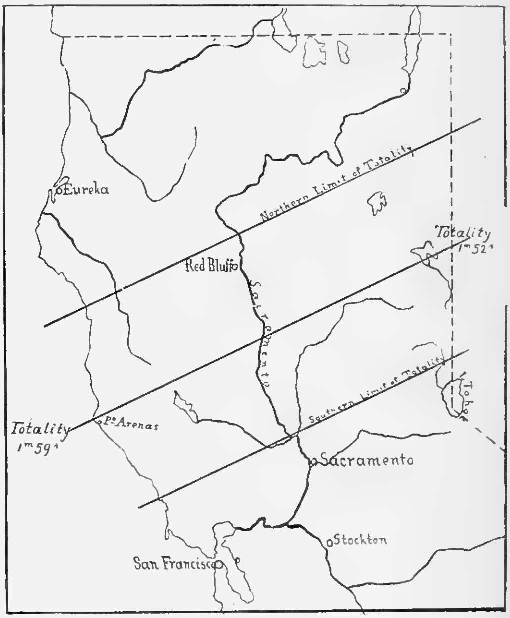
WE take the following from a recent issue of the New York *Electrical Review:* "The Lowth stettio-telephone hails from Chicago, and is a combined transmitter and receiver. A hollow extension about four inches long is attached to the receiver, from the end of which a small button protrudes slightly. The button is placed against the throat near the vocal chords, and the receiver is held against the ear in the usual manner. When the operator speaks, the vibrations of the throat are transmitted with, it is said, distinct clearness. The instrument is operated by the muscular vibrations that accompany the utterance of words. The inventor, James Lowth, is said to have been experimenting and working on this instrument for over ten years. When he first applied for a patent, three years ago, the authorities at Washington thought him a crank, and refused to issue one. He attached the instrument to wires in the office, and asked over it, 'What do you think now?' Back over the wire came, 'I give in. It works perfectly.' Our Chicago informant says it has been successfully operated between that city and Milwaukee, and in Pittsburgh it worked over a line seventy-five miles in length, on which were twenty-five Bell instruments." While, if the evidence is correct, this instrument certainly works, yet it is difficult to see how sounds produced by changing the relative positions of the tongue, teeth, and lips, such as go to make up a large part of the human voice, are accurately transmitted by this telephone. Never having seen one of these instruments, we do not yet "give in."

FAURE'S NEW SECONDARY BATTERY. — In this battery M. Faure uses finely divided metals pressed together in a self-supporting mass, or metal plates are used having combined with them finely divided particles of the same metal. Each plate is surrounded by a sheet of prepared asbestos, the sheet being a thirty-second of an inch thick, dipped first into some soluble salt, and then into a solution of a soluble silicate capable of producing with the first an insoluble compound. In his cell M. Faure uses zinc combined with finely divided zinc, and copper combined with finely divided copper. The solution used is phosphate of potash. On subjecting such a cell to the action of the electric current, phosphate of copper is formed on the surface of the copper element. M. Faure then substitutes a fresh solution of phosphate of potash, and, upon discharging the battery, phosphoric acid is transferred from the solution to the zinc, and from the copper to the solution; so that the solution remains unchanged as regards its constituent elements. The preliminary preparation would be avoided if phosphate of copper were placed upon the copper element in the first instance; but phosphate of copper is not easy to obtain and manipulate, and the process described is said to accomplish the desired object.

AN ITALIAN COMMISSION ON ELECTRIC TRACTION. — The Società Anonima degli Omnibus of Milan some time ago selected three engineers to travel through Europe, inspect the various electric-traction roads in operation, and report on the adaptability to the tramways in Milan. The main part of the report of the experts is taken up with the description and discussion of storage-battery systems; overhead, underground, and rail conductor systems being only incidentally mentioned. The commission was unable to make a report on any line that was a complete financial success. The system in Brussels has not given perfect satisfaction, although improvements have been made that will reduce the cost. The road is on a small scale, however, and it does not necessarily follow that it would not pay, even now, if it was on a larger scale. The road, too, is a difficult one, with long grades of over three per cent. A careful study was made of the different types of accumulators in use at present, and an estimate is made of the comparative cost of storage-battery traction, as compared with that of horses. As a result, the commission advised that electric cars be tried, and states that it would be an honor to Milan, which was one of the first cities in the world to adopt electric-lighting on a large scale, to be also one of the first to utilize electricity for the propulsion of its tramcars.

NOTES AND NEWS.

MR. H. P. TUTTLE has recently indicated on a map of California the shadow path of the total eclipse of the sun which occurs on Jan. 1, 1889, and through his kindness we are enabled to reproduce this map. The cone of darkness will first appear on the western



coast of California, the central line passing near Punta Arenas. The space within the lines marked 'northern limit' and 'southern limit' indicates that in which the eclipse will be total. The duration of the eclipse will be about two minutes.

— During the past week the Society of Amateur Photographers of New York has been holding at its rooms, 122 West 36th Street, an informal exhibition of prints, the work of members of the society. The exhibition has proved very successful; so much so, that, at the request of many visitors, the exhibition will continue until Saturday, Dec. 15. About six hundred pictures are exhibited, and include views in many parts of Europe, China, Japan, Corea, the United States, historical buildings in this city, flash-light pictures, etc. The rooms will be open from 10 A.M. to 6 P.M., and from 7 to 10 P.M. every day and evening this week, except Tuesday evening. There is no charge for admission, and non-members of the society wishing to see the exhibition can obtain tickets by writing to the secretary of the society.

SCIENCE:

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CONTENTS:

THE UNITED STATES HYDROGRAPHIC OFFICE has so largely increased its field of work and usefulness within the last few years, that the hydrographer's report to the chief of Bureau of Navigation will receive attention not only from the naval service and the maritime community, but from a large portion of the scientific world, and the public generally. In fact, there can be no more praiseworthy object kept in view by officers of both the army and the navy than the maintenance and encouragement of public interest in, and acquaintance with, the organization, management, and general conduct of at least such of their offices and bureaus as appeal in any special way to popular interest. There is undoubtedly no branch of the Navy Department to which this consideration is so applicable as to the Hydrographic Office, in view of the recent extension of its field of work by means of the branch offices established already in six of our principal seaports (Boston, New York, Philadelphia, Baltimore, New Orleans, and San Francisco), and authorized in two more (Norfolk, Va., and Portland, Ore.). The importance of this step, carried into effect by the recent hydrographer, Commander J. R. Bartlett, with the support of the chief of Bureau of Navigation, Commodore John G. Walker, is so great, in its relation to the navy, the maritime community, and the shipping interests of the whole country, that a brief review of the working of these branch offices may well be given in this connection. Complete sets of charts, sailing-directions, light-lists, and other nautical publications, are kept at hand, together with standard barometers and thermometers; and masters of vessels can obtain the latest and most reliable information regarding every subject connected with navigation. These facilities have been so generally taken advantage of, that chambers of commerce, maritime exchanges, marine insurance companies, and other commercial bodies, are enthusiastic in their approval. Advantage has been taken of the cordial relations thus established with shipping men to collect a large amount of data relative to hydrography and marine meteorology, much of it of a high order of scientific as well as practical value; and every effort is made to publish the results, in order that they may be known and utilized. Thus the publication of the 'Monthly Pilot Chart' was a very happy thought, and it has become of recognized value and authority, and a most important adjunct in the work of the office. The tabulated statements accompanying the hydrographer's report, giving in detail the work of each branch office during the year, illustrate what an important part these offices play in the collection and dissemination of nautical information. It is highly gratifying to learn from the report of the present hydrographer, Lieut. G. L. Dyer, U.S.N., that the standard of efficiency already attained is likely to be maintained, and even increased, and that, while the relations of the office to the navy are of course regarded as of paramount importance, its *raison d'être* being to supply our vessels of war with reliable charts and nautical information of every kind, its relations to the commercial marine are given their proper share of attention also, and a broad view is taken of the part that the office has taken, and should continue to take, in facilitating the scientific study of every problem relating to the ocean. In this connection too much praise cannot be given to the cordial co-operation between this office and the Signal Service, in collecting and utilizing, without either duplication of work or friction of any kind, meteorological data relative to the ocean and the land.

IN LOOKING OVER the columns of the technical journals devoted to electrical industries, one is struck with the rapidity with which the applications of electricity are being extended. Dozens of new electric-lighting stations are commenced each week, while the applications of electric motors to street-car and stationary work occupy a considerable space in these journals. This is very encouraging, and shows that electric-lighting and the distribution of power have taken a permanent place, and are, under certain circumstances, paying investments. But, at the same time that we read of this rapid growth, we note an extension in another and less promising direction. New companies are being constantly incorporated for the manufacture of electrical apparatus, — lighting and motor systems, storage and primary batteries, fire-alarm and gas-lighting systems, — few of them with a capital of less than a hundred thousand dollars, the majority with a capital varying from that figure to one or two millions. If we will investigate these corporations, we will find that in many of them a large amount of the stock is reserved for the patent rights and for the promoters, and the amount left to supply the working capital is a comparatively small proportion of the whole. The investors find themselves in the position of subscribing the total working capital to a company, paying from the profits liberal salaries to the officers of the company, who are usually the incorporators and the owners of the patents, and who, controlling the majority of the stock, can fix their own compensation; and finally they receive only a small proportion of the earnings, — in many companies from one-half to one-tenth, — if there happens to be any. It should be remembered by investors that patents, unless they are fundamental in their character, are not of very great value. A larger part of the new corporations that have been recently formed operate under patents that are little better than a number of other devices for accomplish-

ing the same purpose. Edison, for his fundamental and valuable patents in electric-lighting, has received less share in the stock of the Edison Company than have the patentees of some small improvement in an electric gas-lighting or fire-alarm device in the companies that have been formed to promote them. It is too often the case that the small cash capital subscribed is used to make a good showing for the company until the promoters have sold their stock, when the company is very liable to suspend. All this very seriously retards the progress of electrical industry. Neither those who lose in companies like the above, nor their friends, are very likely to invest again; and the result is, that the companies that can do legitimate and remunerative work have trouble in getting the capital necessary to develop their business as fast as they would otherwise be able. That there is an immense field for work, and remunerative work, is shown by the wonderful growth of such companies as the Edison, Brush, Thomson-Houston, Westinghouse, Sprague, and others. But we would advise all investors in electrical companies to first find whether they are legitimate business enterprises, with a fair amount of capital allowed for patents, supposing they work under patents, and then to try and find out whether there is any merit in the plan that is to be introduced. The promoters of the company are not the best persons from whom to take evidence as to its value. As for investments in local lighting companies, if there is an efficient management, and if a proper local franchise can be obtained, then, unless a very uneconomical system is chosen, and the local conditions are unusually unfavorable, it is the experience of the last few years that the company should pay good dividends. While we believe, then, that electricity offers an excellent field for investment, and that well-managed companies will pay, yet we cannot too strongly urge investors not to rush blindly into investments on the strength of the representation of interested parties. The advantages of electricity for lighting must lead to its almost universal adoption in the near future, while its adaptability to the distribution of energy opens an almost limitless field for motor-work. The one thing that could most retard its progress would be a condition of public distrust caused by unwise investors, who will equally injure electrical interests and themselves.

THE THIRTEENTH ANNUAL REPORT, which President Gilman has just presented to the board of trustees of Johns Hopkins University, is very interesting reading. It incorporates reports, drawn with some attention to detail, by the various heads of departments, dealing with the specific work accomplished under their respective supervision. This is a feature of considerable value to those who are following closely the development of university work in the United States, and is not unfamiliar, as President Barnard has printed such appendices to his annual report to the trustees of Columbia College for several years past. Mr. Gilman characterizes the academic year 1887-88 as one of steady advance. "The number of students has increased, the standard of scholarship has been maintained, the publications have been as many as ever, the fidelity and enthusiasm of the principal teachers cannot be too strongly commended." Reference to the financial condition of the institution is made in these words: "Our only cause for anxiety is one of which you are fully aware, — the loss of income from the stocks which were given to the university by its founder. Your wisdom, gentlemen of the board of trustees, will no doubt devise some efficient relief. I believe it to be a reasonable expectation that the efforts which you have put forth, and which you have encouraged others to put forth, for the establishment of a university, will receive financial support when you are ready to ask for it." The academic staff included, during the year, fifty-seven teachers. The number of students enrolled during the year was four hundred and twenty, of whom one hundred and ninety were residents of Maryland, one hundred and ninety-six of other States, and twenty-five of foreign countries. Of this number, two hundred and thirty were already graduates of other institutions. The degree of B.A. was conferred on thirty-four candidates, and that of Ph.D. upon twenty-seven, during the year.

The guiding principle upon which Mr. Gilman has developed the university is eminently sound. In view of the numerous newspaper reports and articles concerning Columbia College and its development, the perusal of the following passage from the report before us is recommended to the trustees and faculties of the latter institution. "We continue to adhere," says Mr. Gilman, "to a definition which is hallowed by age and confirmed by experience, that a university is a body of teachers and scholars, — *universitas magistrorum et discipulorum*, — a corporation maintained for the conservation and advancement of knowledge, in which those who have been thoroughly prepared for higher studies are encouraged to continue, under competent professors, their intellectual advancement in many branches of science and literature. In this society we recognize two important grades: (*a*) the collegiate students, who are aspirants for the diploma of bachelor of arts, to which they look forward as a certificate that they have completed a liberal course of preliminary study; and (*b*) the university students, including the few who may be candidates for a higher diploma, that of doctor or master (a certificate that they have made special attainments in certain branches of knowledge); and a larger number who, without any reference to a degree, are simply continuing their studies for varying periods. Corresponding to the wants of these two classes of students, we have two methods of instruction, — the rule of the college, which provides discipline, drill, training, in appointed tasks, for definite periods; and the rule of the university, the note of which is opportunity, freedom, encouragement, and guidance in more difficult studies, inquiries, and pursuits."

THE CLAIMS OF THE ENGLISH LANGUAGE TO UNIVERSALITY.[1]

ALL efforts to create a new language for international use are really unnecessary, because we already possess a vehicle of communication, in our native tongue, which, if not perfect, is sufficiently so, and is at least as good as any that has been proposed. Whatever imperfections may be discerned in English, their removal, if thought necessary, can be easily accomplished in books for foreign learners. But, taking our language *as it is*, and comparing it with other languages, I think I may claim assent to a few fundamental propositions.

The first proposition is, English is as readily *understood* by foreign learners as a foreign language is by English learners. This statement might be strengthened; for the inflection of words in other languages requires much preliminary study to enable a learner to translate; whereas the student of English has only to deal with words which are, for the most part, unchanging, and the full meaning of which, consequently, he learns at once. English is therefore, in reality, *more* readily understood by a foreign learner than a foreign language is by an English learner.

The second proposition is, English is as readily pronounced with *intelligibility* by foreign learners as a foreign language is by English learners. Accuracy of pronunciation, according to native standards, is by no means essential to intelligibility. This is especially true of English. We hear speakers mispronounce every element in a sentence, yet they are understood; and the substitution of one sound for another is a very common habit: as in forming *th* instead of *s*, and "lisping all the hissing sounds;" or "croaking the sound of *r* far back in the rasping throat;" or "protruding the sound through the narrow, rounded aperture of the approximated lips;" or in substituting *t* for *k*, as when little Missie "calls her tiny kitten to come, that she may catch it." We understand the lisper, the burrer, the infant prattler, and the foreign stumbler

[1] Address delivered by Dr. A. Melville Bell before the Nineteenth Century Club, New York, Dec. 12, 1888.

over our speech; and, however imperfect the latter's pronunciation may be, it is in general quite as intelligible as our own attempts at foreign utterance.

The third proposition is, The *correct* phonetic elements of English may be acquired with native accuracy by foreign learners as readily as the elements of a foreign language can be similarly acquired by English learners. The "broken English" of foreigners, and the wretched attempts at foreign speech by school tyros, result simply from the want of timely and precise direction. There is not a sound in any language, which a learner, of any nationality, cannot be taught to produce with all the characteristics of native utterance; and English sounds, as compared with the phonetic elements of other languages, are organically easy of formation. The difficulties of pronunciation which have been complained of in connection with English, arise mainly from the ambiguities of spelling. Let a learner see exactly what he has to pronounce, and he will do so with facility. There are, indeed, clusters of consonants — the very strength of the language — which test articulative ability to enounce them smoothly and without hiatus; but a good speaker delivers them — to quote the words of Austin's 'Chironomia'— "as beautiful coins newly issued from the mint, neatly struck by the proper organs, deeply and accurately impressed, perfectly finished, distinct, sharp, in due succession and of due weight."

The fourth and last proposition is, In regard to the expression of *ideas* with definiteness, fulness, and directness, — the main object of speech, — English is not inferior to any language. Inflected languages are generally briefer in expression; but English, with its separate words, not only for ideas but for nearly all the relations between ideas, is more elastic and variable in construction; admitting of niceties of distinction in phraseology, which are a source of precision and appositeness, emphasis, or elegance in diction.

These propositions merely assert the claims of English to a degree of fitness for international use at least *equal* to that of any language. Other considerations will be found to establish a *supremacy* that is no less indisputable.

The crowning recommendation of the English language for universality is the simplicity of its grammar. In this respect English is immeasurably superior not only to other national tongues, but also to every form of artificial language that has been devised. The various moods and tenses, declensions and conjugations, which burden other grammars have practically no existence for us. We express by combinations of simple words the import of complex inflections. The words are easily learned and remembered; whereas the inflections are perplexing to learn, and their recollection is a constant tax on the memory. If brevity were the principal desideratum, then the meaningful adjuncts to root-words —in substantive, verbal, and other terminations — might be preferable to the detached words by which we convey the same ideas. But brevity would be too dearly purchased at the cost of such a category of shifting enclitics. English is happily almost free from these, but it presents a solitary example of such freedom, as if the language had been predestined to universality, and by this means made ready for its great function. An English word expresses a thought definitely, absolutely, fixedly; the words of an inflected language are unsteady in the mind, and they veer to point after point of the logical compass, under the influence of the little rudders of grammatical inflection.

But, while English grammar is unquestionably the simplest of all grammars, it is still susceptible of further simplification. The chief advantage claimed for some artificial languages is that their rules are absolute, and free from exceptions. But there is no reason why English should not be relieved from its small growth of irregularities, and its rules made equally free from exceptions. For example: its irregular forms of the plural in nouns, and of the preterite in verbs, might be made regular: that is, it might be permissible to form the plural always by adding *s* to the singular, and the preterite always by adding the sound of *t* or *(e)d* to the infinitive, and write 'childs' for 'children,' 'mans' for 'men,' 'mouses' and 'gooses' for 'mice' and 'geese,' 'goed' for 'went,' 'knowed' for 'knew,' 'seed' for 'saw,' 'singed' and 'bringed' for 'sang' and 'brought.' The literary forms of such words would be alternative modes of expression, for which a preference might be indicated because they are established in our literature. The dictionary would read, —

Ox:	*plural* oxes, or oxen.	Do:	*preterite* doed, or did.
Sheep:	" sheeps, or sheep.	Let:	" letted, or let.
Tooth:	" tooths, or teeth.	Seek:	" seeked, or sought.

Such changes need not be prescribed, but simply allowed, *ad libitum*. They would, for the most part, be a mere revival of old forms, many of which are not entirely obsolete.

A few other irregularities might be similarly rectified. For example: why might not degrees of comparison — when not expressed by the separate words 'more' and 'most' — be always formed by adding *er* and *est* to the positive? In this way the words 'gooder' and 'goodest,' and 'weller' and 'wellest,' would be allowable alternatives for the irregular words 'better' and 'best,' which now do duty as comparatives for both 'good' and 'well.' To *legitimize all words formed on accepted rules — without disturbing established exceptional words — would remove the only source of difficulty from the language.* A few more words would be added to the dictionary, but the vocabulary would be enriched by a corresponding increase of phonetic variety.

These suggestions are made now for the first time. The advisability of adopting them must be left to the decision of other minds. But there can be no doubt that the recognition of such alternative modes of expression would be a convenience to learners in their early attempts at *writing* the language.

English has a further recommendation for universality, in its already wide diffusion. It is the vernacular tongue of a far larger number of persons than any other language; and it is undoubtedly studied as a foreign tongue by a larger number than any other. By its phonetics, its copious expressiveness, and its ready intelligibility, English is at least as well adapted for international employment as any language; while, in regard to grammatical simplicity and widely established use, it has a fitness pre-eminent over all other languages, natural or artificial.

How, then, can we account for the fact that this obvious fitness is not universally recognized, and that schemes for artificial languages are still seriously entertained and laboriously developed? The reason is not far to seek. The English language and its orthography are two distinct things. The language is almost all that could be desired; the orthography, almost all that can only be deplored and condemned. Our spelling is disorderly, difficult, misleading, marred both by redundancy and deficiency of letters, and it requires more time and labor to master it than the language itself does. And why? Simply because, for distribution among upwards of forty phonetic claimants, we have only two-thirds of that number of letters. Fully one-third of our sounds are thus compelled to be wanderers and sorners among the letters. This condition of things in human society would convert it into a mass of paupers and criminals. In the republic of letters the results are also depraving. Between letters and sounds there are no acknowledged rights of *meum* and *tuum*; the homeless sounds have to steal a shelter as best they may, now here, now there, among the letters; and the letters have to share their quarters, willy-nilly, with strange interlopers. In plain language, the alphabet is so extremely defective that it *cannot*, without amendment, adequately represent our speech.

How is this necessary amendment to be effected? Here irreconcilable discord arises between words. Each word claims its customary appropriation of letters, and — possession being nine points of the law — each resolutely holds to what it has. "I should not be known in any other dress," says word after word. One adds, "I came from France with the Conqueror;" another, "I hail from classic Rome;" a third, "I boast of Anglo-Saxon origin;" a fourth, "and I of sacred Eastern origin." "I am from Ireland," "I from Wales," say others. Danes, Swedes, and Dutch, Arabians, Spaniards, Greeks, and a host more, assert their claims; and each word points with pride to some poor ragged vestige of old national costume supposed to be distinguishable in its orthography.

But all this attempting to record the nationality of words in spelling has nothing to do with the requirements of popular writing. The spoken *sound*, and not the written sign, is the real word;

and only the sound, and not the verbal genealogy, calls for representation. The derivation of words belongs to etymology, and not to orthography.

Our defective alphabet, and the consequent irregularity in spelling, form the only obstacle to the international diffusion of English. This obstacle may be removed for international purposes without disturbing our own spelling. I now refer for a moment to the system of letters denominated 'World-English,' in which a distinctive character is furnished for each sound in the language. By this means the orthography of every syllable becomes absolutely regular. A large proportion of the common alphabet is retained unchanged in World-English, but each letter is limited to the expression of one single sound. New letters are, of course, introduced for unrepresented sounds, and these are designed to resemble old letters as much as possible. The effect is, that any reader of ordinary English deciphers World-English without the slightest difficulty. At the same time — the writing being perfectly phonetic — the exact pronunciation of every word is indicated in the spelling.

I need not say any thing more concerning World-English, except in reference to certain prevailing misconceptions as to the scope and object of the system. Some critics have looked on the new orthography as only a fresh attempt at spelling-reform; and they argue, that, as the new letters are not to be found in every printing-office, the introduction of the system must needs be hopeless. This view is entirely a misconception. World-English does not interfere in any way with ordinary spelling. The object is simply to provide a separate method of learning to read and speak the language, for the benefit chiefly of students in foreign countries, but incidentally also as a help to beginners at home. Books, magazines, and newspapers do not require to use a single one of the new letters.

Other critics have objected to the association of English sounds with the vowel-letters *a, e, i*, as giving a preference, they say, to narrow usage over the wide usage of Continental Europe, which would require these letters to be sounded *ah, ā, ee*. This is another misapprehension of the system. The World-English alphabet is not — like that of Visible Speech — a universal alphabet. Its exclusive object is to teach ONE language, and to do so with as perfect conservation as possible of the phonetics of ordinary letters. To have associated the sounds *ah, ā, ee*, with the letters *a, e, i*, would have defeated the very purpose of the scheme. World-English does not assimilate English to other tongues, but only facilitates the acquisition of the language, exactly as it *is* spoken in England and America.

My allotted space does not permit me to say more. I trust, however, that this brief statement will have sufficiently established the claims of English to universality. I have confined my remarks to this single point. If the language were merely as well adapted as any other for international use, its being the native tongue of the two greatest nations on earth should decide the question of its superiority for social, commercial, and scientific intercourse throughout the world.

Volapük, Lingua, and other schemes proposed for universal language, will, I fear, prove but wasted efforts. The field is occupied. Every zone is being covered with broad growths of world-overspreading English. Let us improve, while we may, what none can supplant, and none need wish supplanted. World-English has performed one not unimportant service, in showing how established spelling may be preserved, while the orthographic obstacles are removed that have hindered both the diffusion of the language, and its *recognition*, as the most fit medium for international communication universally.

HEALTH MATTERS.

The Pollution of Water-Supplies.

DR. CHARLES SMART, surgeon U.S.A., presented a report at the recent meeting of the American Public Health Association on the pollution of water-supplies.

The report gives special emphasis to the conclusion reached at the previous meeting, that, when there is sewage in a water-supply, there is danger of typhoid infection. Some of the evidence is briefly cited; and the financial interests involved are held responsible for the hesitancy to acknowledge this specific danger, for as soon as a city relieves itself from the oppression of the moneyed interests, and procures a wholesome water for its citizens, it immediately recognizes the connection between sewage and typhoid. Vienna recognized this connection when it found, that, by substituting the water of a mountain-stream for the sewage-water of the Danube, its annual deaths from typhoid fell from three hundred and forty to fifty, and shortly afterwards to eleven, in every hundred thousand of the population; and an improved sewerage system had nothing to do with this, as the sewerage system was in existence during the period of high typhoid rates.

The efforts made by municipal authorities and water companies are then passed in review. The advantages of sedimentation, which is the method generally adopted in this country, are recognized, and particularly when sedimentation is promoted by the use of precipitants, such as chloride of iron, as recently suggested by L. H. Gardner of New Orleans, La. The changes that take place during storage are held to be purifying in their nature, notwithstanding the vast increase in the number of bacteria developed in the stored waters. The slowness of the sedimenting process, often necessitating a large expenditure for storage-basins, has led to the experimental use of such filtering-beds as are employed so generally for municipal supplies in England; but the expense attending them is large, and the coldness of our winters begets difficulties which are not encountered in the milder climate of England. Attention is then directed to the patent filters that have of late been manufactured for use on a large scale. Their ability to furnish a clear water is conceded; but the object of the filtration of a water-supply for domestic or public service is its wholesomeness when used for drinking, and its transparency gives no testimony on this point. Artificial filtration has neither the time nor the surface to effect percolation after nature's methods. In these artificial filters, as much water is transmitted under pressure in half an hour as nature purifies on the same area annually. Bacteria of nitrification, which effect the purification during the passage of a water through the soil, cannot be harnessed to the work of the artificial filter. Artificial filtration consists of the mechanical separation of a water from its suspended impurities, while the essential of natural filtration is the thorough nitrification of the dissolved albuminoids of the water, the removal of the suspended matters being incidental and merely secondary.

But although sedimentation and filtration give a more or less clear water, and one in which the organic matters that are prone to decompose are destroyed and rendered harmless by bacterial agencies, if an infected sewage has entered the water, the living germs of typhoid-fever are not removed or deprived of their virulence by any of these modes of purification. The infected water which prostrated twelve hundred of the eight thousand inhabitants of Plymouth, Penn., and killed a hundred and thirty of those whom it prostrated, passed through three storage-reservoirs on its way to accomplish its deadly mission; and the springs of Lauzun, in Switzerland, contained the germs and propagated the disease, although their waters had undergone a thorough filtration. From the particulars of the latter epidemic, it is held, that, while sewage irrigation may give effluents that will preserve our streams from becoming open sewers, it will never furnish a water which can be afterwards used as a drinking-supply.

The conclusion reached is an emphasized reiteration of that of every committee which has investigated this subject, — that a water to which sewage has had access should, from that fact alone, be excluded from all further consideration as a possible water-supply for domestic purposes. Money is held to be all that is wanting to solve the question of pure water-supplies. Engineering difficulties fall into insignificance when surveyed from a satisfactory financial standpoint. It is often said to be beyond the power of money to purchase health, but the sanitary student can readily demonstrate that in many cases this is not so. Money expended in the distribution of a wholesome water-supply will purchase health for the thousands who otherwise fall victims to the fever which is endemic in our cities and towns. Typhoid-fever is a disease to which every one is exposed. The susceptibility to it is inherent in our consti-

tution, and, so far as we know, immunity can be purchased only by submitting to attack. We are surrounded by its infection, and cannot escape. Ordinarily the human constitution succumbs to its influence before maturity is reached; but if, up to that period, we fortunately escape, we have no assurance of future immunity. Uncertainty overhangs us like a cloud. Danger is as present with us in the daily routine of our peaceful lives as on the battle-field, only that the embodiment of evil is an invisible and intangible germ instead of a fast-flying bullet. Danger flows beside us in our streams, in our mains, from the taps in our houses. The germ of disease may not be in this pitcherful or in that, in this tumblerful or in that, but it will find us some day if we continue to use the water which contains it. In a town of fifty thousand inhabitants, one victim is taken daily; and, as the average duration of this fever is about a month, there are always in that city thirty persons whose lives are unnecessarily trembling in the balance. What is the local suffering from yellow-fever in Jacksonville, Pensacola, or New Orleans, once in so many years, compared with the totality of the devastation caused by the steady progress of this general and ever-present scourge? Thirty thousand people die of typhoid-fever annually in the United States of America; and Vienna lowered her losses by this fever from three hundred and forty to eleven annually in every hundred thousand of her population by introducing a spring-water supply instead of the sewage-tainted waters of the Danube. Calculate the loss by sickness associated with these thirty thousand deaths, — the loss of work, the unprofitable work of nursing, and the actual outlay necessitated by each visitation of the disease, — and you will find that saving money by drinking sewage in the water-supply is a penny-wise policy, that, in the long-run, will fail to pay even for the funerals and mourning goods.

The importance of acting promptly is insisted upon, as, the longer a community procrastinates, the greater is the difficulty experienced in procuring a desirable supply of water, owing to the increasing density of the population of the surrounding country. Having obtained a pure supply, every square foot of the drainage area should be familiar to the sanitary inspector, that the life and health of the citizen may not be endangered by that which was intended as a benefit. Every case of typhoid-fever occurring on such an area should be specially watched, and the infection of the dejecta destroyed. But as the efforts of local authorities, such as water companies and boards, citizens' committees, health boards and commissioners, would often be powerless without the intervention of the authorities of the State, a livelier interest in this important matter is urged on the part of the State boards of health, — an interest which is not satisfied with discussing and subscribing to views of the subject, but which will leave nothing undone that will tend to invest them with power to act for the preservation of the public health. With all our boards operating, each within its domain, there would be no need of committees to investigate the subject of water-pollution.

The report concludes with a resolution that will tend to strengthen the hands of the State boards, — that it is the well-considered belief of the American Public Health Association that great good would accrue to the public health, particularly in the denser settlements, if State legislatures would give their boards of health that financial support which would enable them to act intelligently on all questions pertaining to the public water-supplies, investing them with the supervision of the said supplies, and with power to preserve them from contamination by sewage or other injurious matters.

BOOK-REVIEWS.

The Young Idea; or, Common-School Culture. By CAROLINE B. LEROW. New York, Cassell.

THE lady who has with much labor compiled this little book has done a genuine service to the cause of educational reform: for she has pierced the shams of the present curriculum with the shafts of ridicule, and so reached many readers who would have paid no attention to a more formal argument. In 'English as She is taught,' the same writer attacked one branch of instruction: in the present book she attacks the vicious principle that runs through the teaching of all the branches. That she has worked to some purpose is testified by the sneers of *Education*, an ardent defender of every thing that is worn out; for, argument in reply failing, some harsh expletives and ill-timed jibes were resorted to by that antiquated periodical in order to break the force of Mrs. LeRow's indictment.

It would be a serious mistake to suppose that Mrs. LeRow's object is to amuse, though her book contains many amusing things. "Repugnant, one who repugs," is the natural answer of a boy who has been taught what the schoolmasters are pleased to call etymology, by the mechanical method. As the author suggests, the child who defined arithmetic as the "sins of numbers" had an almost supernatural insight into the difference between the way in which he was being taught and the way in which he should be taught. And the following is too good to pass unnoticed (we will all agree with Mrs. LeRow that it would have rejoiced Lord Byron's heart): "A critic is something to put your feet on to." The self-evidence of this will also be appreciated by all but the book-writers and book-publishers: "Grammar is something to talk good, and is devided into digrams on the blagboard. I cant never learn to do grammar." "The Saxon Cronical was the seven deadly sins," is a sufficiently startling statement to indicate that bad teaching is not confined to the lower grades: it seems to reach at least to the history classes.

These quotations might be multiplied at great length, but to cite too many of them would perhaps emphasize too much the merely illustrative side of Mrs. LeRow's work. She is not jesting: she is in sober earnest. She knows of what she writes. She has been in the schools, and seen and heard what she speaks of. She has a gospel to preach. It is a protest against educational indifference, a call to the study and criticism of educational methods. To remedy these defects and bring about the necessary reforms, many things are necessary. Politicians and time-servers must be ejected from the school-boards; inefficient and mechanical superintendents and principals must be retired; and raw, untrained, and immature girls, yet in their teens, must no longer be given an opportunity to dull and stupefy thousands of child-minds under the protection and in the service of the State. Until public opinion is aroused, no one of these steps can be taken, and Mrs. LeRow should be loyally aided and encouraged in her self-imposed task of arousing public opinion.

Hand-Book of Historical and Geographical Phthisiology, with Special Reference to the Distribution of Consumption in the United States. By GEORGE A. EVANS, M.D. New York, Appleton. 12°. $2.

IN this volume Dr. Evans has given us a sketch of the development of our knowledge of pulmonary consumption from the time of Hippocrates to the present day, together with the ascertained facts regarding the geographical distribution of that affection. In addition to this, he has arranged the statistics in regard to this distribution in the United States so as to make them available for convenient reference in selecting localities of resort or residence for invalids, and also for those who are in health. He coincides with Hirsch in designating consumption as a ubiquitous disease, extending over every part of the habitable globe. Taking the mean death-rate of the whole of a population to be twenty-two per thousand, the average of deaths from phthisis would be nearly one-seventh of the whole mortality, or three per thousand, of the population. Estimating the total yearly mortality of the world to be thirty-five million, five million of these deaths are attributable to consumption, — the greatest number caused by any single disease.

The consideration of the geographical distribution of consumption in the United States is based on the 'United States Census of 1880,' and Rand & McNally's 'Atlas of 1887.' The same is true of those portions of the book which treat of the topography and climate of States, and of the number of deaths from consumption in the different States and cities. The etiology of the disease is discussed at length, and the views of Hirsch, Hunter, Lindsay, Bowditch, Elliott, Hermann, Müller, Koch, and others, are referred to.

Concerning the conclusions which may be deduced from the evidence submitted in regard to the geographical distribution of phthisis, Dr. Evans says that he can do no better than to quote the

following brief summary from Hirsch: "Phthisis is everywhere prevalent, but is rare in polar regions, and rarer still at great altitudes. The main factor in its production is overcrowding and bad hygiene. Heat and cold, *per se*, have no influence. Damp, when conjoined with frequent oscillations of temperature, predisposes to the disease; but humidity of the air is less important than dampness of the soil. Occupation is extremely important, but mainly indirectly, as tending to good or bad hygienic conditions." With reference to the part played by the tubercle bacillus, Dr. Evans says it is reasonable to believe that it holds the same etiological relation to pulmonary phthisis that certain other micro-organisms hold to external surgical affections, to septic diseases of the (post-partum) uterus or its contiguous tissues, etc. He thinks that there can be no doubt that pulmonary phthisis occasionally terminates in recovery, and refers to cases reported by competent observers in which such a result has followed. He believes that the respiration of antiseptic air by phthisical subjects will be found in the future to be as successful in the treatment of consumption as topical antiseptic influences have been in the treatment of external surgical affections.

Although Dr. Evans states in the preface that his treatise is made up, to a great extent, of the observations of others, and for the most part in their own words, still he deserves great credit for the admirable manner in which he has arranged the material, and for the excellent judgment displayed in selecting from the writings of others all that is most valuable, and pertinent to the subject.

The Story of Holland. By JAMES E. THOROLD ROGERS. New York, Putnam. 12°.

THIS book, the last in the Story of the Nations Series, is in some respects an admirable work. The author's conception of history, and his view of what is important in human affairs, are excellent. In particular, he gives but small space to those military operations which are the main element in most popular histories, and confines himself to the far more essential movements of political, intellectual, and commercial life. He conceives very clearly and correctly the part played by Holland in the history of modern Europe, though we think he overrates its importance. He declares that "the resistance made by Holland to the Spanish king was infinitely more heroic, far more desperate, much more successful, and infinitely more significant," than that made by the Greeks against the Persians; and this is surely a gross exaggeration. The Greeks were the founders of civilization, and its very existence depended on the success of their struggle, and this cannot be said of the Dutch war or any other in history. Nevertheless the great importance of the Dutch contest is undeniable, not merely as affecting Holland itself, but even more in its influence on the politics of Europe. For two centuries the little republic was one of the chief centres of European life; and Mr. Rogers shows clearly how intimately her prosperity was connected with that of the great nations around her. The war of independence necessarily occupies the chief place in the story; but the decline of her freedom, and her influence, are also narrated, and the causes of the same are made plain.

With the general conception of Mr. Rogers's work, then, there is little fault to find; but we cannot say the same of the execution. The author seems to assume that his readers are already familiar with the history of England and the general history of Europe; for he perpetually alludes to events outside of Holland which no one not thus informed can possibly understand. The worst example of this is in the thirty-third chapter, which treats of the war of the Spanish succession. The author does not announce his subject at all, but begins by making indirect allusions to it; and nowhere in the chapter is there any clear statement of what the war was about. In the same chapter Marlborough is frequently alluded to, and always by that name, and then all at once he is spoken of as John Churchill. But there is also a still worse defect in the book: it is full of grammatical blunders and other mistakes of language, the most frequent being the disagreement of the verb with its subject Thus, we read that "piracy and buccaneering was practised;" that "scenes like those of 1672 was threatened;" and that "the spirits of the Dutch was a little raised." So the author says of a certain Englishman that he "learnt all his learning from Dutch sources," and elsewhere alludes to certain bad harvests as "even more disastrous in France than they even were in England." Such blunders occur at frequent intervals throughout the book, and seriously detract from its merit.

Patriotic Reader; or, Human Liberty Developed. By HENRY B. CARRINGTON. Philadelphia, Lippincott. 8°.

THIS book is a collection of extracts from various writers and speakers, expressing the sentiment of patriotism, and intended to cultivate that sentiment in the mind of the reader. The authors are mostly American, and the passages given are on various topics, such as the lives and character of eminent men, the deeds of heroes, the blessings of liberty, the future of America, and other themes on which our popular writers and orators are fond of descanting. One chapter consists entirely of "Patriotic and National Hymns, Songs, and Odes," while the rest of the book is mainly prose. Many of the passages given are excellent, but we confess that in the book as a whole there is altogether too much hifalutin and self-glorification to suit our taste. This constant boasting of our country and her institutions is both disagreeable and mischievous, as tending to develop national conceit. Our political organization and our fundamental laws are indeed excellent, but our civilization as a whole is by no means high; and it behooves us to think of our deficiencies and try to remedy them rather than to be perpetually glorying in the liberty our fathers gave us. The compiler of this book, however, seems unaware that we have any deficiencies, and therefore the most important duties of the patriot at the present day cannot be learned from his pages.

The Economic Interpretation of History. By JAMES E. THOROLD ROGERS. New York, Putnam. 8°.

PROF. MICHAEL FOSTER has spoken, in a recent paper, of the possibility that in the future the sciences of morphology and physiology may come together again, because of the interdependence of their subject-matters, form, and function, just as the growing specialization of science started them on different lines in the not very remote past. The same thing is true, in a most interesting and suggestive sense, of history and economics. The former is the morphology of society, and the latter its physiology; and, while they have been far apart in the past, they are clearly approaching each other at present. The so-called 'historical' school of economists, and the so-called 'historical' method in economic science, are evidence of this; and Prof. Thorold Rogers, in the Oxford lectures which constitute the book before us, has done something to make the community of the historical and economic fields intelligible. The writer's elaborate researches into the condition of labor and wages in England for the past six hundred years, have made possible — perhaps suggested — the present volume.

The keynote of the book is struck in the following passage from the preface: "The distrust in ordinary political economy has been loudly expressed by workingmen. The labor question has been discussed by many economists with a haughty loftiness which is very irritating. The economist, it is true, informs them that all wealth is the product of labor, that wealth is labor stored in desirable objects, that capital is the result of saved labor, and is being extended and multiplied by the energies of labor. Then he turns round and rates these workmen for their improvidence, their recklessness, their incontinence in foolishly increasing their numbers, and hints that we should all be better off if they left us in their thousands, while there are many thousands of well-off people whose absence from us would be a vast gain. I have never read, in any of the numerous historical works which political economists have written, any attempt to trace the historical causes of this painful spectacle, or to discover whether or no persistent wrong-doing has not been the cause of English pauperism. . . . My treatment of my subject, then, is as follows. You have a number of social or economical facts, many of them containing problems of a serious and urgent character. So serious are they, that many persons — an increasingly large number of persons — demand, if no other solution is to be given, that society must be constructed on new lines, as Frankenstein made his man, or monster. To meet these people with the law of supply and demand, to point out to them the bliss of unrestricted competition, and to rebuke them with the Malthusian law of population, the Ricardian theory of rent, and the margin of unproductive cultivation, is to

present them with logomachies which they resent. . . . Many of the problems which vex society have an historical origin, sometimes a present cause, though more rarely. Now, I have made it my business in these lectures . . . to examine into and expound the history of social facts." Professor Rogers does not fail to express himself as to the folly and shortsightedness of purely speculative economics. Passages where his opinion concerning such treatment of his science is freely made known abound in these pages. One of the cleverest and most timely is this: "Perhaps the most remarkable Nemesis which has come on the speculative economist is that the definition of Population by Malthus, and the definition of Rent by Ricardo, have been made the keystone to Mr. Henry George's theory, under which he demands the confiscation of Rent in the interests of Population."

The close connection between the rise and power of the great cities of Germany and Italy, and the development of transcontinental commerce, we all know about. We are not so clear, however, about the historical causes of early English labor legislation, of the rise of the various forms of tenancy, and of ship-money; or about the economic effects of the guilds, the apprentice system, and the income-tax. On all of these subjects Professor Rogers writes clearly and learnedly.

The valuable chapter on the origin and history of *laissez faire* is, in our judgment, one of the very best in the book. We should go a step beyond Professor Rogers in criticising that principle and pointing out its inherent fallacies; but his very conservatism on this subject, and the measured force of his words, will carry greater weight with his *laissez-faire* countrymen than would an analysis of a more radical and far-reaching character. We lay the book down with the feeling that in reading it we have obtained a clearer insight both into the economic facts of the past and into the economic science of the future.

AMONG THE PUBLISHERS.

MODERN art has been so largely and so directly influenced by the French schools of painting, that a new work which analyzes and traces to its source this influence will be sure of a hearty welcome. The comprehensiveness of Mrs. Stranahan's 'A History of French Painting' (New York, Scribner) is its distinctive feature. More than any other national art except Italian, and more than any other modern art whatever, the course of French painting has been an evolution. Each school has clearly arisen out of national æsthetic conditions, and each one has legitimately developed its successor. No work, of the same general kind even, so distinctly presents this scientific historical interest as does this 'History of French Painting.' The book is compact with biographical and other statistical details, and has an account of the fostering of art by the State, which in France has always played so large a part in æsthetic development. An account is given of the French Academy of Painting, with its *salons*, schools of instruction, etc.; and not only the masterpieces of French painting, but all works of either individual interest or historical importance, are critically described, and their location in public and private galleries is pointed out. It is useful as a book of reference and for general reading. The paintings which have been reproduced include Meissonier, Millet, Troyon, Bouguereau, Watteau, Gérôme, David, Poussin, Daubigny, Bastien-Lepage, etc.

From 'A History of French Painting.' THE THREE MUSES. *Charles Scribner's Sons.*

— *The Popular Science Monthly* for last July contained an article on house-drainage, which excited much interest and criticism. This vital subject will be further treated from various points of view in the January *Monthly*, in an illustrated article by Dr. John S. Billings, U.S.A., who is an acknowledged authority on sanitary science. Among other articles, we note 'The Guiding-Needle on an Iron Ship,' by Lieut.-Commander T. A. Lyons; and 'Science and its Accusers,' by W. D. Le Sueur. In the same number Mr. E. R. Shaw will tell how he made geometry a pleasure to his pupils, using the 'Inventional Geometry' prepared by Herbert Spencer's father.

— The November number of the *American Meteorological Journal*, Ann Arbor, Mich., contains articles on 'The Influence of Forests upon the Rainfall and the Flow of Streams,' by Prof. George F. Swain, of the Massachusetts Institute of Technology; on 'Tornadoes,' by Dr. Gustavus Hinrichs, director of the Iowa Weather Service; and on 'Diurnal Cloud and Wind Periods, at Blue Hill Observatory during 1887,' by H. H. Clayton; etc.

— A. B. Ward, the author of 'Hospital Life,' in a recent issue of *Scribner's*, will contribute to the January number 'The Invalid's World,' which includes the doctor, nurse, and visitor. It is now known that 'A.B. Ward' is the pen-name of a woman. Dr. George P. Fisher of Yale will write regarding the amenities which should be observed in all respectable controversies, but which are generally violated. In General Alexander's article on 'Railway Management,' the mystery of making time-tables will be explained. Ex-Postmaster-General Thomas L. James will contribute an article on 'The Railway Postal Service,' and W. C. Brownell's group of essays on 'French Traits' will be continued. The Right Rev. Henry C. Potter, bishop of New York, will contribute the final paper to *Scribner's Magazine* for February. It is in the series by eminent men, which replaces Mr. Stevenson's monthly essays.

— Instead of enlarging the *Writer* and increasing its price, as its publisher had planned, he will publish a companion monthly, to be called the *Author*. The first number is promised Jan. 1, and will contain selected and original matter of special importance to writers.

— For young people, the 'Children's Stories of the Great Scientists,' by Henrietta Christian Wright (New York, Scribner), equals in interest the author's two previous books, which have attained popularity as supplementary readers. It deals, in a simple, entertaining manner, with sixteen of the great men of science, giving a brief, readable account of their lives and of what discoveries they made. The narratives are fresh and animated, having that graphic picturesqueness which is rarely found in the treatment of such topics. The portraits of Galileo, Newton, Franklin, Agassiz, Faraday, Darwin, and others, reflect excellently the characters of the men. These short biographical chapters contain a large amount of information on almost every branch of science.

LOUIS AGASSIZ.
From 'Children's Stories of the Great Scientists.' *Charles Scribner's Sons.*

— D. Appleton & Co. have now ready 'The Household History of the United States and its People, for Young Americans,' by Edward Eggleston. A school edition of this work was published last September.

— "The book of the week," says G. W. Smalley in the *Tribune* for Dec. 2, is "Earl Stanhope's 'Notes of Conversations with the Duke of Wellington.' This little volume abounds in anecdótes of the most interesting kind; interesting, above all, as giving the duke's opinions in his own words on people and events in his own time."

— Harper & Brothers published last week the handsomely bound book of 'Old Songs,' illustrated by Edwin A. Abbey and Alfred Parsons. They will publish on the 14th, in their popular Young People Series, another volume by Kirk Munroe, entitled 'Crystal Jack & Co.,' but which also includes a shorter story, 'Delta Bixby;' Mr. Howells's new novel, 'Annie Kilburn;' and Walter Besant's 'All Sorts and Conditions of Men.'

— The committee on publication of the Grolier Club, New York, announces in *The Publishers' Weekly* of Dec. 8, that, owing to unavoidable delays in the editing, and in the preparation of suitable type and engraved ornaments, it has been impossible to issue, as early as anticipated, the long-promised new edition of the 'Philobiblon.' This work, it may be interesting to note, was written by Richardus d'Aungerville, an English prelate, called also Richard de Bury, who was born at Bury St. Edmunds, in Suffolk, in 1281. He was educated at the University of Oxford, and entered the order of Benedictine monks. On the accession to the throne of Edward III., whose instructor he had been, he was promoted to various offices of dignity, and was finally made bishop of Durham, as well as lord high chancellor and treasurer of England. At Oxford he founded a library for the use of the students, which he furnished with the best collection of books then in England; and for the keepers of this library he wrote the 'Philobiblon,' which contains directions for the management of the library, and an elaborate eulogy of learning, and the most charming treatise on the love of books, in Monkish Latin, which was first printed at Cologne, 1473, then at Spires, 1483, and finally at Oxford, 1599. In his researches abroad, Professor West of Princeton discovered in the various public libraries of Europe a number of early manuscripts of the 'Philobiblon,' and has made an exhaustive study and collation of these, adopting the reading which, upon comparison, seemed to him authentic. The result, it is hoped, has been the production of a text and translation which will probably hereafter be considered as the

only true and genuine edition of Richard de Bury's treatise. All the early printed editions, without exception, have been found full of errors, and the translations based upon them are of course incorrect. The new book will be furnished to subscribers as soon as it can be properly done, about April 1, 1889. Subscriptions will be received up to the 10th of January next, when the lists will be closed, and the printing proceeded with without delay.

— *The Atlantic Monthly* for 1889 (published by Houghton, Mifflin, & Co.) will contain in addition to the short stories, essays, sketches, poetry, and criticism, three serial stories, — 'The Tragic Muse,' by Henry James; 'The Begum's Daughter,' by Edward L Bynner; and 'Passe Rose,' by Arthur Sherburne Hardy (this story began in the September number, and will continue until April). American subjects will be discussed by Mr. John Fiske, whose articles on these topics are equally thoughtful and engaging. Several novelettes, in two and three parts, will appear during the year. From time to time *The Atlantic* has contained important papers on topics relating to education, by men of large experience and of exceptional ability to discuss educational principles and methods. It will contain similar papers in the future, as important questions shall arise; also occasional poems by John G. Whittier, essays and poems by Oliver Wendell Holmes, occasional papers and poems by James Russell Lowell, and several poems by Thomas Bailey Aldrich. Contributions during the year 1889 may be expected from John G. Whittier, Oliver Wendell Holmes, James Russell Lowell, Francis Parkman, Charles Eliot Norton, T. W. Parsons, Thomas Wentworth Higginson, P. G. Hamerton, Charles Dudley Warner, E. C. Stedman, F. Marion Crawford, Harriet W. Preston, Sarah Orne Jewett, 'Charles Egbert Craddock,' Mrs. L. C. Wyman, Edith M. Thomas, Horace E. Scudder, J. P. Quincy, George E. Woodberry, Herbert Tuttle, William C. Lawton, George Frederic Parsons, Maurice Thompson, Lucy Larcom, Celia Thaxter, Julia C. R. Dorr, Agnes Repplier, Olive Thorne Miller, Bradford Torrey, Percival Lowell, Octave Thanet, Margaret Deland, and many others. *The Andover Review* (published by the same firm) is a religious and theological review, under the editorial control of Professors Smyth, Tucker, Churchill, Harris, and Hincks, of the Andover Theological Seminary. The November and December (1888) numbers of both magazines will be sent free of charge to new subscribers for 1889 whose subscriptions are received before Dec. 20. Houghton, Mifflin, & Co. publish also *The Journal of American Folk-Lore*, a quarterly magazine, each number containing about ninety-six pages, octavo, edited by Dr. Franz Boas of New York; Prof. T. F. Crane of Cornell University; the Rev. J. Owen Dorsey of the Bureau of Ethnology, Washington, D.C.; and Mr. W. W. Newell of Cambridge, Mass., general editor.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

The Moon's Light for Geodetic Signals. — Electric Storms on High Peaks in Nevada and Utah.

TRIALS of the moon's light with a view of determining its effectiveness for signals in the primary triangulation of the Coast and Geodetic Survey were undertaken by William Eimbeck, assistant in the survey, in 1883, at Pioche station, Nevada. The results obtained over a line of twenty-two miles in length were sufficiently promising to warrant a resumption of the experiments over longer lines.

In 1887 the occupation of Mount Nebo — a station of the transcontinental triangulation in central Utah, at an elevation of twelve thousand feet above sea-level — afforded the desired opportunity. At three of the stations of the triangulation connecting with Mount Nebo the heliotropers were duly instructed to show the moon's light for two hours continuously between the 29th of June and the 4th of July, the moon's age between these dates ranging from first quarter to full moon. They were to begin during twilight, or about forty-five minutes after sunset, and to substitute for their heliotrope-mirrors reflectors of extra size, proportioned to the length of the respective lines of sight. These were forty-eight statute miles to Draper, seventy to Onaqui, and ninety-seven to Ogden; and the diameter of the mirrors ranged from six to eight inches at Draper, eight to ten inches at Onaqui, and twelve to eighteen inches at Ogden.

The atmospheric conditions proved unfavorable, high winds, a murky atmosphere, and a decidedly hazy sky prevailing, except upon the nights of the 2d and 3d of July, when the lights from the selenotropes at Draper and Onaqui were plainly visible in the illuminated field of the telescope. Distinctness and steadiness were the most striking characteristics of these signals. They shone as mere dots of white light, and, for precise pointing, were of ideal perfection. The light at Ogden was not seen.

Mr. Eimbeck's conclusion from these trials is, that during a period of from twelve to fifteen days in each lunation the moon's light can be used to much advantage for geodetic signals in the altitudes of the arid regions of the interior, upon lines trending in all directions, if they do not exceed about fifty miles in length.

Referring to the electric thunder-storms that prevail in the higher mountains of Nevada and Utah during July and August, and not unfrequently hover about the King Peaks for days in succession, Mr. Eimbeck observes that these storms are at times very severe, and not without danger. They were especially so towards the close of the occupation of Mount Nebo in July, and also at Tushar and Jeff Davis Peaks, lasting for over seven days. The violence of the electric exhibitions, and the almost constant detonations of the discharges of electricity, were so grand and overpowering that the parties of heliotropers stationed at Tushar and Jeff Davis Peak abandoned their stations in alarm for their lives. Those at Tushar returned after the storm had abated, but those who had been at Jeff Davis Peak (13,100 feet in height) refused.

The effect of these storms upon experienced officers of the survey is to produce a great strain upon the nervous system, and the sudden fall of temperature with which they are attended is a source of much physical discomfort. With the mercury almost down to freezing-point and an atmosphere of moist iciness, the body becomes benumbed, and the mind sluggish. There is also the apprehension, not without reason, of instant death by lightning. The summit of one of the peaks was often struck, and also the tent occupied by the men, but fortunately at a time when no one was in it.

EDWARD GOODFELLOW.

Washington, D.C., Dec. 5.

Answers.

40. FELSPAR, OR FELDSPAR? — This mineral name seems to have been first used by Wallerius in 1747, in his 'Mineralogia,' in the form 'felt-spat,' meaning field-spar. The early German form was 'feld-spath.' In the appendix to the English translation of Cronstedt's 'Mineralogy' (p. 8) we have it 'field-spar.' In Edwards's 'Fossilogy,' 1776, we have (p. 54) 'feltspat,' going back to the Swedish form. Kirwan, in 1784, 'Mineralogy' (p. 124), has the form 'felt-spar.' In the second edition of his 'Mineralogy,' however (1794, vol. i. p. 317), Kirwan has the following note: "This name seems to me derived from *fels* ('a rock'), it being commonly found in granites, and not from *feld* ('a field'); and hence I write it thus, 'felspar.'" This unwarrantable assumption of Kirwan was followed by later writers, and so the corruption came into use. In Schmeisser's 'Mineralogy' (1795, vol. i. p. 131) we have only 'feldspar.' Jameson (1804, vol. i. p. 275) says 'felspar,' but in a footnote, "More properly 'feldspar.'" Phillips, in his first edition, gives both derivations, i.e., from *feld* and *fels*, but in the later editions only from the former. Cleaveland (1822) uses 'feldspar,' while Thomson (in 1836) says 'felspar.' In Dana's 'Mineralogy' (fifth edition, 1868, p. 352) we find, "Feldspath, *Germ.*; feldspar, *Engl.*; felspar, *bad orthogr.*" Webster's, Worcester's, Stormouth's, and Skeat's Dictionaries derive the word from '*feld* spath,' though both spellings are given. It is clear, therefore, that the original word was 'feldspar,' and that 'felspar' is a corruption from a mistaken idea of its origin. But the latter has been used so much, and for so long, that it has its place in the language, and no one who prefers it can be criticised for using it.

ALBERT H. CHESTER.

Hamilton College, Clinton, N.Y., Dec. 10.

Publications received at Editor's Office, Nov. 19–Dec. 1.

ALASKA, Report of an Expedition to the Copper, Tananá, and Koyukuk Rivers in the Territory of, in the Year 1885, made by Lieut. H. T. Allen. Washington, Government. 172 p. 8°.
ALLEN, T. F. The Characeæ of America. Part I. Introduction, Morphology, and Classification. New York, 10 E. 36th St. 64 p. 8°.
BARTON, S. The Battle of the Swash and the Capture of Canada. New York, C. T. Dillingham. 131 p. 16°. 50 cents.
BAUER, G. Spelin. A Universal Language. Tr. by Charles T. Strauss. New York, Charles T. Strauss. 28 p. 12°.
BURT, B. C. A Brief History of Greek Philosophy. Boston, Ginn. 296 p. 12°. $1.25.
CARRINGTON, H. B. Patriotic Reader. Philadelphia, Lippincott. 595 p. 12°. $1 20.
CLARKE, J. M. Report on Bones of Mastodon or Elephas, found in Association with Human Relics in the village of Attica, Wyoming Co., N.Y. Albany, J. B. Lyon, Pr. 7 p. 8°.
CORY, C. B. Hypnotism or Mesmerism Boston, Mudge. 61 p. 12°.
DAVENPORT, R. B. The Death-Blow to Spiritualism. New York, G. W. Dillingham. 247 p. 16°. 50 cents.
ERDE, Die. Lief. 36–40. Leipzig, Hartleben. f°.
ETHERIDGE, R. Fossils of the British Islands. Vol. I. Palæozoic. Oxford, Clarendon Pr. 468 p. 4°.
FISKE, J. The Critical Period of American History, 1783–1789. Boston and New York, Houghton, Mifflin, & Co. 368 p. 12°. $2.
GREELY, A. W. American Weather. New York, Dodd, Mead, & Co. 286 p. 12°.
——Report on the Proceedings of the United States Expedition to Lady Franklin Bay, Grinnell Land. Vol. I. Washington, Government. 543 p. 4°.
HAZEN, H. A. Hand-Book of Meteorological Tables. Washington, The Author. 127 p. 8°.
HOLBROOK, M. L. Eating for Strength; or, Food and Diet in their Relation to Health and Work. New York, M. L. Holbrook & Co. 236 p. 12°.
KAY, D. Memory: What it is and How to Improve it. (Internat. Educ. Ser., Vol. VIII.) New York, Appleton. 334 p. 16°.
LANCIANI, R. Ancient Rome in the Light of Recent Discoveries. Boston and New York, Houghton, Mifflin, & Co 329 p 8°. $6.
MACOUN, J. Catalogue of Canadian Plants. Part IV. Endogens. Montreal, Dawson Bros. 248 p. 8°.
MORAL and Scientific Companion. Vol. I. No. 1. Florence, Arizona, Eugene Arthur Browne. 4 p. f°. 50 cents per year.
NUTTALL, Zelia. Standard or Head-Dress? (Archæol. and Ethnol. Papers of Peabody Mus., Harv. Univ., Vol. I. No. 1) Cambridge, Peabody Mus. 52 p. 8°.
PENNSYLVANIA Geological Survey. Atlas Eastern Middle Anthracite Field, Part II. Harrisburg, State. 8°.
PROCTOR, R. A. Old and New Astronomy. Parts VI. and VII. London and New York, Longmans, Green, & Co. 128 p. 8°.
ROGERS, J E. T. The Story of Holland. New York, Putnam. 388 p. 12°. $1.50.
SERVISS, G. P. Astronomy with an Opera-Glass. New York, Appleton. 154 p. 8°. $1.50.
WALSH, W. S Paradoxes of a Philistine. Philadelphia, Lippincott. 192 p. 16°. $1.
WRITER'S Handbook, the. Philadelphia, Lippincott. 148 p. 12°. $2.50.

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SCIENCE

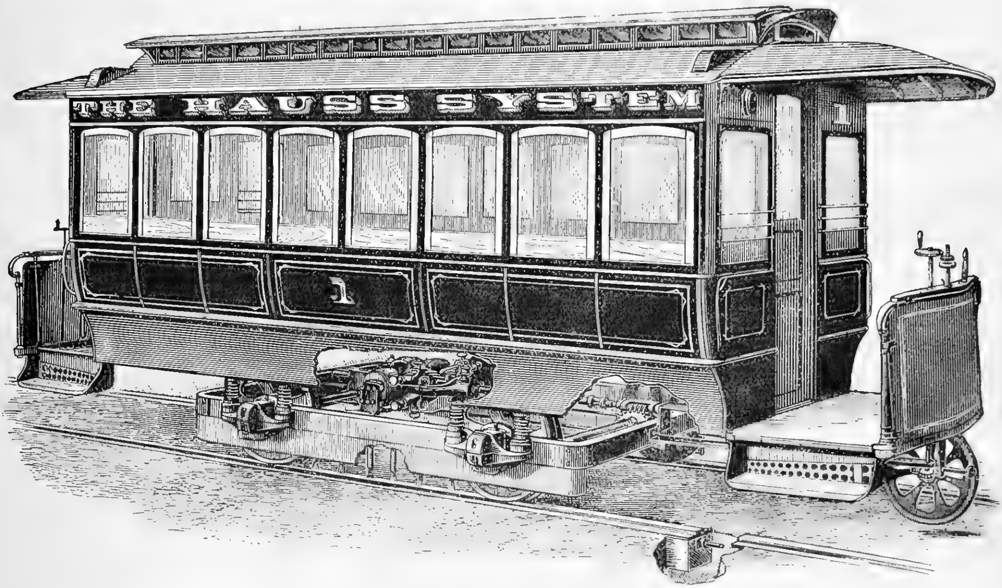
FRIDAY, DECEMBER 21, 1888.

THE HAUSS ELECTRIC RAILWAY.

ALTHOUGH that which has been accomplished within the past ten years in the applications of electricity to the arts of civilization affords a never-failing theme of interesting comment, it is more than probable that we have really only witnessed thus far the beginnings of its possible applications. We may anticipate, from the varied forms in which electricity will ultimately be applied for the ransmission of power, results even more remarkable than those which have followed its application in the field of illumination. It is well established that the energy of the electric current may be conducted, with comparatively little loss, over great distances; and the practical possibilities which this fact suggests of employing this agent as an advantageous substitute for steam in the production of motive power are fully appreciated by the army of able and ingenious inventors who are directing their energies to the practical side of electrical science. It is gratifying to know, also, by the admissions of so eminent an electrician as Professor Ayrton, that in this direction American electrical engineers have advanced considerably beyond their European brethren; for, while we have thousands of electric motors driving machinery of various kinds in this country, they are, with a few notable exceptions, practically unknown in Europe.

The most interesting and important of the problems involving the utilization of electricity for the transmission of energy is that of the electric railway. The successful solution of this problem, it is safe to say, will prove a great blessing to our cities in definitely settling the question of rapid transit. That sooner or later a method of electric transmission for this important service will be found, is something that no one disputes; and the eagerness with which intelligent people of all occupations follow the details of every new experiment having this for its objective point, affords the best evidence that the right method will receive a warm and unanimous welcome when it makes its title clear to the claim.

The conditions which an electrically operated railway in the streets of a city must fulfil are difficult of attainment. It must be entirely free from danger; it must be simple in construction and operation; and it must be an economical system in respect of first cost, maintenance, and operation. An additional point will be gained if a system of this kind could be devised by which the rolling stock of the present tramway companies could be utilized. The system that shall most fully realize these conditions will have successfully solved the problem of the electric railway for city service.



THE HAUSS SYSTEM OF ELECTRICAL TRACTION.

We have lately had the opportunity of examining and witnessing the operation of a system of electric railway for which claims of unusual merit are made. It is the Hauss electric railway, controlled by the Hauss Electric Company, and we shall devote some space to the consideration of its merits. As these may best be made conspicuous by comparison, we may properly consider the features of the several electric railway systems now in use.

The various systems now before the public may be enumerated as follows: first, the overhead system; second, the third-rail system; third, the use of the two rails as conductors; fourth, underground conduits; fifth, storage-battery; sixth, the Hauss insulated, sectional, underground system.

Respecting the system employing an overhead conductor, it may be said that its characteristic feature — the necessity of employing lines of posts and wires strung overhead — is an objection of the most serious character, which is practically prohibitive of its use in the built-up sections of cities, leaving out of the question the

serious troubles encountered in switching and crossing where many cars are used.

The third-rail system has in many cases been discarded, on account of the danger of receiving shocks to which persons and animals are exposed in crossing the rails, and on account of the great loss by leakage due to the extreme difficulty experienced in maintaining proper insulation.

The system using the rails as conductors has been discarded, because of the same objections that have just been urged against the third-rail system. The objections to the underground conduit system are the great first cost; the necessity and the expense of tearing up the streets, which in many cases prohibits its adoption; and the necessity of providing for its perfect drainage, which, in connection with the serious troubles in maintaining insulation, greatly adds to the cost of its maintenance and the running expenses.

The storage-battery plan, at first thought, would seem to be the ideal system. It dispenses with the necessity of a continuous conductor, the electrical generator and motive power are all contained within the car, and there is apparently an entire absence of any possibility of danger to passengers. These favorable anticipations would be justified were it once demonstrated that a storage-battery had been devised that was economical of power, of reasonable weight, and durable in service. Thus far, however, the best storage-battery that has been devised is very wasteful as a source of motive power, yielding at most but forty per cent of the power applied, excessively heavy and bulky, making it necessary to carry about three times the load of an ordinary car, and requiring a special car to be built to provide the necessary space beneath the seats to receive the batteries, — a matter of very notable importance, since it prohibits the use of the rolling stock of the surface roads without considerable cost for alterations. Furthermore, the storage-battery, as thus far developed, has a life of only two years of constant service, and it is subject to the danger of short-circuiting, which at once destroys its usefulness. Whether any or all of these deficiencies, which at present seriously interfere with its usefulness, may be remedied in the future, is a question which time alone can determine. It is sufficient for our present purpose to know that the storage-battery, in the best forms of to-day, is seriously handicapped by reason of these objectionable features.

The construction and mode of operation of the Hauss system will be understood from the following explanations: —

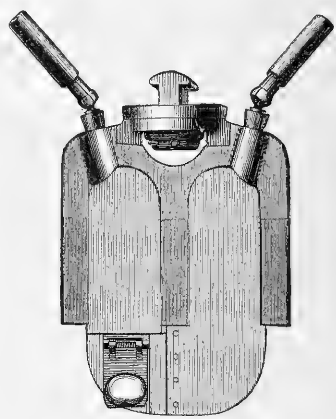
In this system an insulated wire is used, covered with rubber and other material known to be highly efficient in the case of underground electric-light wires. This wire is placed in a groove in the stringer underneath one of the rails, and is passed through metallic pockets, which are also placed underneath the rail. In order to obtain additional insulation, the stringer is coated with asphaltum. The metallic pockets are placed beneath the rail having the grooved stringer carrying the line-wire. The rails on this side are made in sections, each twelve feet long, each section being insulated from adjacent sections. When the car passes over the rail, contact is made with the wire in the pocket, and the current is collected by means of guard-brushes and the wheels. The entire length of the track is dead, and the only portion which is charged is a space twelve feet long directly under the car. When the car leaves one twelve-foot section, this section immediately becomes dead, and the next section over which the car is then passing becomes charged. There is at no time any portion of the track charged except that portion directly under the car, thus not only insuring against all danger to persons or animals, but also insuring efficient insulation along the entire route, and preventing a heavy leakage of current. The current is conveyed from the guard-brushes and the wheels to the motor, and through the other rail to the ground.

The speed or direction of the motor can be controlled from either end of the car. The motor is built as light as is consistent with the best electric results (a twenty-horse motor, weighing one thousand pounds), and the armature is run at a very moderate speed. The efficiency of the motor is affirmed to range, by actual test, at about ninety-five to ninety-eight per cent. The power is applied directly to the axles of the car by means of a worm and worm-gear, the latter being placed on each of the axles, and the worm connected directly to the armature shaft and provided with two ball-and-socket joints, to compensate for any slight derangement in the relations between the motor and the shafts. The motor is bolted to a frame hung on the axles of the car, and fastened rigidly to the journal-boxes. The springs rest on the journal-boxes, and support the body of the car. The motor and truck are entirely independent of the car-body, and have no connection therewith. The motor can be geared so as to run the car ten or more miles an hour, and, as we witnessed at the trial of the system, can be perfectly controlled from the slowest movement up to full speed, and instantly stopped or reversed, if necessary, without injury to the machinery. No hand-brakes are required with this system, as the wheels are automatically locked when the armature ceases to revolve. In going down grade, there is no danger of the operator losing control of the car, and no possibility of the car running away. Another feature introduced on the car is a fifth wheel, shown suspended at the front end, which can be let down, and by means of which the front end of the car can be jacked up. When thus resting on three wheels, the car can be led around any obstruction and brought back to the track, connection with the track-conductor being temporarily made with flexible conductors. By this system the cars are able to leave the track, to go around a breakdown or an obstruction, to go over fire-hose when stretched across the track, or to cross over and take the back track. Finally, there is not an inch of room required for passengers that is used, and not a sign to denote the use of electricity in the propelling of the car to be seen above the floor. By this system, it is claimed, the cost of running is brought lower than has been possible with any other thus far devised, and the claim appears to be based on reasonable grounds.

The simplicity of the motive mechanism is such as to insure the minimum of trouble in operation; and the entire system, in respect of economy of construction, maintenance and running, and absolute safety, appears to have eminent merits.

THE CONDUIT SYSTEM OF ELECTRIC RAILWAYS.

AMONG all the different types of motors which have been pressing their respective claims upon the attention of the public during the last few years, there is none which can compare with the electric motor in its efficiency, its adaptability to all sorts of work, and its practicability as a means for the distribution of power from a

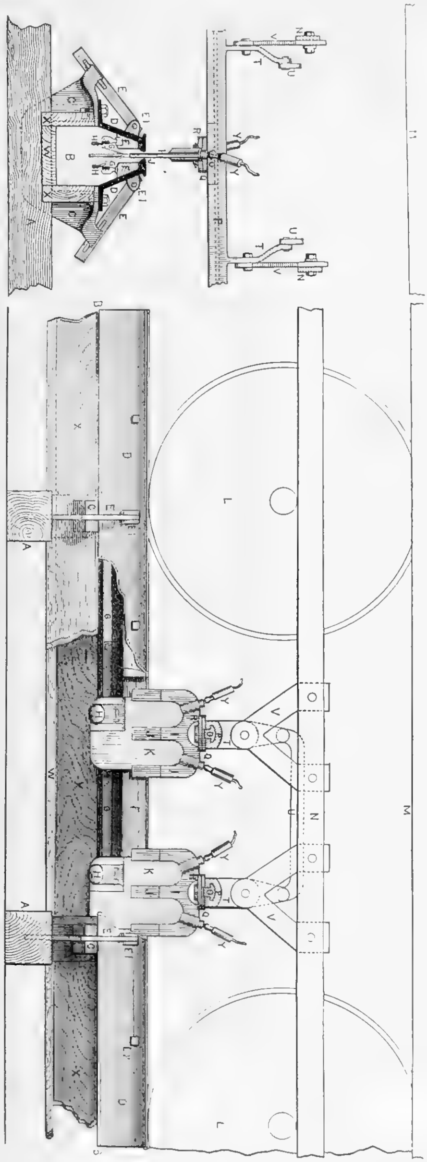


CONTACT DEVICE.

central station at a moderate expense. The number of electric motors now in every-day operation, and the extended range of the uses to which they are put, are matters furnishing constant surprise to all who are unpossessed of the latest information on these points.

One of the most interesting of the applications of the electric motor is found in the electrically propelled street-car of to-day which has already created a revolution in the field of locomotion and which promises in the near future to be as commonplace an

familiar as the horse-car now is. In this system the conductors are necessarily bared throughout their entire length, and must be protected both for the safety and convenience of the public and also to prevent injury to the conductors themselves. These requirements are fully satisfied by the underground conduit, which promises to be an indispensable element upon all urban lines.



A, tie; *B*, conduit; *C*, iron yoke; *D*, slot steel; *G*, conductor; *H*, contact shoes; *I*, contact device or plough; *L*, car-wheel; *P*, *Q*, *R*, traveller and swivel; *Y*, flexible conductor.

This system has been developed by the Bentley-Knight Electric Railway Company of New York City, who claim to control by patented rights all practicable methods of locating the supply conductors in a conduit, and who, however this may be, have built the only roads operating on this plan. Either between or outside of the track-rails is laid a conduit about fifteen inches in depth and ten inches in width, consisting of iron yokes set up from three to five feet apart, and slot steels bolted thereto, leaving an opening at the surface of the street of only about five-eighths of an inch. The direct and return supply conductors, consisting of copper bars united by expansion joints, are supported by suitable insulators in the upper part of the conduit, where they are out of the way of any slush and dirt which may collect therein. These conductors are placed opposite each other, and are connected in circuit with the dynamos at the central station. The car carries a plough or contact device, which extends down through the slot into the conduit, and has two contact-shoes insulated from each other, which rub against the two line-conductors. Flexible conductors in circuit with the two shoes extend up to the car, and are in circuit with the terminals of the propelling motor; so that, as the car travels along the track, the two housed conductors are constantly connected through a travelling loop circuit supplying the motor with current.

The shank of the plough is narrower than the slot, and the contact-shoes can be folded into line therewith, so that the entire plough can be inserted or moved from the conduit at will; and accidental breaking of the plough is guarded against by providing a spring catch normally holding the plough in place, but adapted to give way should any accidental obstruction be struck. In order to compensate for any curves or irregularities in the line of the slot, a transverse guide is provided upon the vehicle, and a traveller at the upper end of the plough moves freely along this guide, while swivelling or other jointed connections may be employed when found desirable. The car is propelled by either one or two motors of about fifteen horse-power, which are generally placed underneath the car-body, and centred around the axles, to which they are connected through intermediate speed-reducing gearing. The usual brakes are provided for stopping the car, while circuit switches and resistances control the speed and power of the motors with all the precision and nicety of which steam-motors are capable.

From this description the essential features of construction in the conduit system, as well as the mode of their operation, will be readily understood, but many questions touching upon the practical working of the system will suggest themselves to those interested in it as a commercial enterprise: Will the conduit become filled with dirt or with snow? Can the necessary insulation of the underground wires be maintained? Will the car have sufficient traction? What will happen if the car runs off the track? All these objections have been anticipated, and it is found that the satisfactory operation of the conduit road built by the Bentley-Knight Company at Allegheny City, Penn., demonstrates that they are groundless. This road, which is known as the Observatory Hill Passenger Railway, is about four miles in length, the conduit being employed for about one-fourth of this distance, and it has been in continuous operation since the first day of January, 1888. There are thirty-four curves on the line, not including turnouts and switches. The maximum grade is $9\frac{29}{40}$ feet in 100 feet, on a length of 400 feet, and this is on a reversed curve (radii 100 and 200 feet). The sharpest curve has a forty-foot radius on five-per-cent grade. Greater natural difficulties than these can scarcely be found on any street-railway in existence, and hence the successful working of the road during the severe snows and ice of the last winter is perhaps the best guaranty of the practicability of the system. Other conduit-roads are now under process of construction by the same company, noticeable among which are one of over three miles in length, contracted for by the West End Railway Company of Boston, and the Fulton Street Road of New York City. The progress of these roads will be watched with interest.

That for the West End Company in Boston is just completed, and will be put into operation in a few weeks, and thoroughly tested.

PHILOSOPHY AND SPECIALTIES.

ON Saturday evening, Dec. 8, the annual address of the retiring president of the Philosophical Society of Washington, Col. Garrick Mallery, U.S.A., was delivered before a very large audience, composed not only of the members of the Philosophical Society, but of those of the Anthropological, Biological, Chemical, Geographic, and Woman's Anthropological Societies, whose attendance had been

invited. The subject was 'Philosophy and Specialties;' and in the publication of an abstract we are compelled to omit all the ornamentation.

Colonel Mallery said that only three centuries ago the chief seats of learning were successfully challenged by a scholastic knight-errant to a dispute on any subject and all subjects, or, as it was derisively phrased, "*de omnibus rebus et quibusdam aliis*." In the days of the Admirable Crichton it was possible for one mind to grasp the total of existing knowledge, and this was because science had not yet risen above the misty horizon. The study of facts and their co-ordination had not supplanted the two most prominent schools depending severally upon revelation and intuition.

The quality of revelation prohibited discussion upon it even as an explanation of phenomena, but allowed of reasoning from it within the usual limits of orthodoxy to be decided by the physically, not mentally, strongest battalions. So all that once represented science was mythology, especially in its grand division of demonology.

An opposite scholastic system, prevalent in its time, started in the tenet that intuitions should decide on the nature of things and the perfect type of their origin, to be ascertained by man's own ideals, not from observed data. The examination of a sound mind in a sound body being difficult, he was then the greatest teacher who had most enormously tumefied his inner consciousness, and could exhibit its morbidity with the most pretentious diagnosis. Subject to this leadership in introspection, every man was his own universe. Though specimens of such effete concepts still survive in folios, they are not found in the working libraries of science.

When, therefore, there was no attention to facts as such, and knowledge was either a commentary on revelation or a ratiocination on self, it was not so difficult to know every thing. To-day the pretender to universal knowledge will be denounced as knowing nought. This judgment is carried to an extreme. Even the exceptional minds, whose multiplied facets scintillate brightness in diverse angles, are denied glory as light-bringers on each line.

This is necessary, for phenomena are infinite, and science must deal with all as observed. In the formulation of its induced laws, no compromise is admitted, as in politics or ethics. But this infinite is composed of the infinitesimal, — atoms, molecules, protoplasms, or whatever name may be invented by our ignorance, — and it is by the study of these minutiæ that science exists. So this is the era of specialties. No freshly discovered fact is without its significance, and may in its relations solve the most obscure problems. The original investigator now must not only be a specialist, but must work in some subdivision of a specialty.

This was illustrated in several of the sciences, in the professions of law and medicine, and also in art. The recent progress of specialization was shown by the fact that nine years ago the Philosophical Society was the only scientific society in Washington, embracing all branches. Since then the Anthropological, Biological, Chemical, and Geographic were founded, and the Mathematical Section of the Philosophical Society established. An account of these, with their several functions, was given.

However essential division of labor, specialization, and analysis may be, they are nevertheless only means to the ultimate aim of generalization and integration, which constitute wisdom, and its construction is by synthesis.

Within the most circumscribed of specialties there must always be an attempt to reach law through details. The solution of a problem without application of it is like playing a game of solitaire where time and skill give no result. Mathematics, apart from their gymnastic training, would be useless if their integrals should remain meaningless. Each asserted fact must be tested by varied experiment, which often results in failure. The truth of to-day has sometimes been the paradox of yesterday, and may become the falsehood of to-morrow. Admitted facts must be compared with all other facts related to them. Confutation must be challenged. Without this process, science would be a jumble of inconsistent opinions, so that cavillers might have excuse for a jibe that whatever is not sense is science. While such testing and comparative discussion should exercise its function in each specialized society, it is yet more important that the results, as appearing to its specialists, should be examined with the greatest freedom by specialists in other lines; and this examination is not only for further verification and comparison, but to extend the area of acquired science. Practically science is only the existing condition of human knowledge, which of necessity is incomplete; though its form, to be science, should not be a broken surface, but a series of steps by which greater heights are gained. For these reasons all specialties should be tried before a court of general jurisdiction, — an Areopagus. In course of time, doubtless, the press brings forth scattered judgments of such a universal tribunal; but a hand-to-hand contest must be more active and decisive than a protracted war, conducted by the discharge of heavy books at long range, or by the skirmishing shots of pamphleteers. If scientific association is to do the most good, some time and place for trial by battle should be provided, which cannot be done in any or in all of the specialized societies by their separate work.

The propriety of scientific contest on a common plane is readily illustrated by the yet undetermined controversy between geologists and physicists respecting the age of our earth. As neither side can yet speak without contradiction by the other, neither should speak except in the hearing of the other. A more popular illustration is in the historic fight between ordnance and engineers; that is, scientific attack by artillery or its equivalent, and material defence by fortifications or similar protection. In no systematized war department can either the officer of ordnance or of engineers be confided in, except when, after experiment satisfactory to his own corps, his demonstration shall overcome the corps of his complementary antagonist.

Thus by the interrelation and counteraction of specialties there is mutual correction, ascertainment of truth, and promulgation of law.

After discussing the work and functions of the American Association for the Advancement of Science, the Congress of American Physicians and Surgeons, and other organizations, the term 'philosophy' was more closely examined. The old 'philosophers,' while professing to seek the truth, did not do so, but asserted that they had it already, and that their sole work was to teach it to others. As before hinted, this philosophy was axiomatic, and closely connected with theology, by which forces and factors were postulated but not comprehended. Logic and mathematics do not detect errors in axioms and postulates when once admitted. Verities by common consent were adopted *a priori*, which verities, belonging to a low stage of culture, were universal errors, and therefore in accord with all existing reasoning. The teachers found it convenient to reason from the species to the genus, and from the particular to the general, by words instead of by ideas; that is, by verbal sophisms. Crude conceptions were employed to make words, which the elasticity of languages permitted, grammatic form and euphony being the only limits. This superannuated scholasticism has been generally called 'metaphysical,' but is more properly 'antiphysical.' Its combined stupidity and pretence have to some minds inflicted a stigma upon the title 'philosophy' which it arrogated. Modern re-action from the fetichistic worship of this monstrous phantasm may have been too violent.

The terms 'science' and 'knowledge' are perhaps convertible in usage, as in etymology, but neither of them is synonymic with 'philosophy.' Professor Mach defines 'knowledge' as 'an expression of organic nature;' but that is not true, unless by knowledge he means true wisdom. Knowledge is the 'mere material of which wisdom builds.' Claude Bernard is partly right in stating that philosophy makes a specialty of generalizations. That, however, is measurably true also, as before stated, of each one of the sciences. Without proper synthesis, they do not exist as sciences, but are mere uncouth mosaics. Each special science must have a philosophic side, and the co-ordination of all of those sides constitutes philosophy in general. In this sense it is not merely the specialty of generalizations, but the generalization of generalizations. Without it the several sciences rest with no common bond, and do not form a synthetic and organic whole. Their fundamental hypotheses are liable to overthrow, because they are not criticised and revised by logical co-ordination. The method of science is to test hypothesis by experimentation and continued observation. From a sufficient number of results a proposition or law is induced, the authority of which increases with the number and weight of those results. It

is not a valid objection that generalizations, even obtained *a posteriori*, have often been erroneous. So much the greater necessity for their trial by a proper tribunal; for the end is to establish from particular facts a general law, which thereupon may be considered as a principal fact, explaining and showing the relations between the facts which it governs. This second course is deductive, in which the value of the conclusion is that of the premises. The collection of and proper deduction from, more strictly the application of, such principal facts or induced laws, is the domain of philosophy.

The vocabulary employed by an ecumenical society should be different from that proper to a specialty. It should be such as is understood by an audience of good general education. It is true that the actual operation and formulation of thought in many branches, notably chemistry and botany, besides mathematics, requires the elaborate technical language and symbols invented for them; and in all lines of study condensation and determination have demanded neologisms, which increase daily with new facts and thoughts. But workers with these newly fashioned terminologic tools become too fond of and dependent on them.

In the use of specialistic and coined terminology, not only pedantry may be observed, but the old juggle with words, in which pretended novelty is only mystification. Greek compounds are convenient as brands or labels, but do not make thought less, and often leave it more obscure. Polysyllables and water are bad, but polysyllables and mud are worse. Such obscuration of truth is a serious injury. From these views it must be admitted that philosophy, being broader than any science, — than all the sciences together, — cannot be limited by the formulation peculiar to any of them, and therefore its language should not adopt the terms of any, but use such as are generally understood and accepted.

This admission at once brings up the subject of style in its broadest scope. The prime requisite of style in philosophic as distinguished from specialistic writing is, that it should be clear to all; the second, that it should be attractive. It is not so easy to be clear; and Sheridan's phrase, "Easy writing's curs'd hard reading," is enforced by the confession of so great a thinker and writer as Charles Darwin. Style is not confined to vocabulary or ornamentation. It is the treatment which, by the mental work of presentation, the author putting himself in the place of the reader, enters into substance, and translates from his own mind to many minds. A large number of examples were given of the use of style well and ill, by scientific and non-scientific modern writers of English.

It is not proposed, however, to offer a disquisition on style. But as Wesley once protested, in words rendered more pungent by Elder Knapp, against "the Devil having all the best tunes," it is desired to enter a vigorous protest against fiction having all the best English. Two suggestions only will be ventured, both perhaps unexpected. The first is that poetry should be incorporated, not injected, into a scientific production. This does not renew the adjudicated claim of the imagination — "the vision and the faculty divine" — to scientific use, but refers to the manner of expression. Never let prose get into your poetry, but put all the poetry you can invoke into your prose. Molière's hero was astonished to learn that he had been talking prose all his life without knowing it; and, conversely, our best prose-writers on the heaviest subjects might find that the poetry in their prose was the secret of their success. This conception of poetry does not mean the evanescent prismatic tints on the bubbles of a scientaster or scientulus, — whichever term may suit the diminutive pretender, — but the informing and vitalizing light, which not only refracts and reflects, but radiates from an original source. The spontaneous characterization of the highest order of prose writings is that they are full of light, fire, and life; and the term 'poet,' applied to their authors, shows its true etymology, — the maker.

The second plea is for the admission of wit and humor into scientific writing. No one, not even Sydney Smith's Scotchman, is willing to confess his imperception of humor. Nevertheless nature has not given it to every one; and to those to whom it is denied it is as the absence of a sixth sense, by which absence much happiness is lost. This enumeration of humor with the senses is scarcely forced, for man has been styled the 'laughing animal,' as best distinguishing him from other orders. Neither the grin of some simians nor the cachinnation of the hyena, nor any similar demonstrations by other animals, represent human smiles and laughter. The deficiency may be compared with unappreciation of the arts in general; but the histrionic art is that on which there is least controversy. Every man who is in the normal possession of his senses appreciates perfect acting. Dr. Johnson suffered from bad vision and hearing, and therefore never could reconcile himself to the overwhelming success of his friend David Garrick as an actor. Translate his physical imperfections, while admitting his general judgment, into terms of humor, and it may be understood how many good and wise people fail to enjoy it. With them the dogma is naturally cherished that a witty man is always shallow. Sydney Smith, who knew whereof he spoke, says, "The moment an envious pedant sees any thing written with pleasantry, he comforts himself that it must be superficial." Many people admire sententious monotony, even if it be stupidity, and are shocked too much for their delicate nerves at the sudden presentation of an intellectual surprise. Yet what is more forcible? Is there any mode in which truth can be more strongly presented than by its humorous opposite? If the dry *reductio ad absurdum* is legitimate, how much better is it when laughter brings an echo! Laughter must be: therefore philosophy cannot ignore it.

Both science and philosophy are separated from literature by well-established boundaries. Passing by philosophy for the moment, the distinction between science and literature may be sharply drawn by recognizing that science deals with facts regardless of the vehicle of their expression. Literature, on the contrary, may disregard all facts as such, while occupied with reflection and sentiment; and in it the form of expression is essential. There is a literature of science and of all the sciences; but few scientific works can be embraced in literature, if only because of their defective form.

The favorite but not vallated domain of literature is æsthetics in its true meaning, — viz., that which is perceived or apprehended by the senses, but limited to what is desirable to be so apprehended, the beautiful (the Greek *το καλόν*), — and, even if the spirit of literature abandons this Elysian realm, the form cannot depart from it and live. Specimens of literature may properly be stigmatized as bad, — bad in tendency and effect, as in their influence upon morals, religion, politics, and the like; but literature cannot be bad in form, because, if its form is not æsthetically good, it is not literature at all. It has been asserted that in literature the substance is of little moment — only the form, the manner in which the things are written, and not the things. An argument can be made in support of this dictum. Even the utilitarian must admit that the struggle for perfection in language — comprising vocabulary and grammatic form — for itself alone has presented to both science and philosophy their vehicle, and has established for humanity its imperial distinction over the rest of living beings.

Some advocates of form *versus* substance might quote favorite passages of Emerson or Browning that cannot be understood, as is proved by so many diverse interpretations. But while æsthetic form is undoubtedly essential in literature, comprehensible thought must be there also. The smoothest iambics and most stately hexameters which exercise in Latin prosody the scholars of Eton and Harrow, technically styled 'nonsense verses,' are not literature.

It may seem bold to assert that literature should not meddle with science, when every novel brings into its machinery some scientific statement or discussion, and as fast as each new discovery appears it is seized upon by the romancer for his plot as a *deus ex machina*. But, if this employment is more than machinery or incident, the novel becomes a dilute treatise, and is not proper literary work.

A rough contradistinction may be outlined, that science deals with facts, the thoughts being secondary; literature with thoughts, the facts being secondary; but philosophy includes equally the facts and the thoughts relative to them. Science supplies food, but neither savor nor digestion; literature pleases the appetite; philosophy with appetite digests the food. Again: to science the language used is subordinate; to literature the language is paramount; to philosophy the language is essential, but not paramount.

It remains to offer the suggestion that philosophy should also be

regarded from the significance of its etymology, — the love of wisdom. Lessing said, that, if it were necessary to choose, he would prefer to have the love of truth to the possession of truth itself. By this paradox he meant to emphasize his desire for wisdom, not for repletion by facts and cold encyclopedic knowledge. The mere possession of truth, not strictly wisdom, may be that of a miser who hoards and does not circulate it to the common good; but the love of wisdom brings wisdom. "Be there a will, and wisdom finds a way." "Wisdom crieth aloud, she uttereth her voice in the streets," and it will be regarded. "So teach us to number our days that we may apply our hearts unto wisdom."

SCIENTIFIC NEWS IN WASHINGTON.

Causes of Configuration in Trees. — How Some Eskimo Measure. — A New Improved Freezing-Microtome.

Causes of Configuration in Trees.

THE influences under which a tree assumes one shape instead of another are obscure even to the students of vegetable dynamics. External forces are added to hereditary forces in every growth. The mechanical forces at work, affecting plants externally, are mainly gravity and atmospheric pressure (wind).

B. E. Fernow, chief of the forestry division of the national Department of Agriculture, recently read a paper setting forth some valuable observations.

The physiological forces are termed 'stimuli,' and produce re-actions only on the growing tissue, and are characterized by the disproportionality between the external stimulus and the ultimate re-action. These forces work accidentally and occasionally, often changing the environment of an organ; and such alterations may occur by a change in the intensity or direction of the light, variation of temperature, instantaneous shocks, sudden pressure, etc. The capacity to re-act to these stimuli is called 'irritability,' the presence or absence of which is a sign of life or death.

The various parts of a plant re-act differently to the same stimulus, and according to their type of structure. The internal capacity of a part of an organ to re-act to external influences determines its external form and the direction of growth: thus radial structures are usually orthotrop (tending to place their axis toward the acting force), dorsiventral structures act plagiotropically (tending to place their axis obliquely or transverse to the direction of the acting force).

But there is also seen what may be termed a vicarious correlation' of the different structures, by which the development of one organ is changed in its direction by the development or lack of development of the other; thus, also, a plagiotropic organ becomes orthotrop. The most common example of this correlation is seen when the main axis is cut off, and a side-branch takes the orthotropic nature of the main axis.

The stimuli that effect changes of direction in various parts of plants — aside from accidental ones, like pressure, contact, moisture, heat — are mainly light and gravity; the re-action to light being termed 'heliotropism,' and that to gravity being 'geotropism.' In regard to the latter re-action, there appears to be a misapprehension as to the nature of gravitation, as usually accepted, and as stated by Sachs, Darwin, Wiesner, and others.

It seems illogical to assume that gravity, conceived to act everywhere and constantly, could be considered as determining the direction of the primary root vertically downward, of the secondary roots obliquely downward, and of the other classes of roots growing without reference to this always active force.

That the direction of the different parts is a resultant of several forces, among which gravity may be one, is hardly intimated by these writers; and the dominion of gravity is so forcibly stated that the occasional reference to modifying influences does not impress us as a necessary and important consideration.

The effects of heliotropic (light) stimulations are the opposite from those called 'geotropic,' or a bending toward the light. But the effect of light upon root-forming matter is to turn it away from the light; and upon shoot-forming matter, to turn it toward the light; while dorsiventral structures adjust themselves obliquely across the direction in which the light strikes the irritable organ. The latter behavior is highly important, and reveals the purpose of this re-action, which results in the largest surface of chlorophyl-bearing cells being exposed to the light, and inducing the chemical changes upon which growth depends.

Intensity of light, however, may become injurious, and hence the presence in some plants (*Mimosa*) of an ability to change the position of the leaves with reference to the optimum light intensity. As the light is diffused equally in the atmosphere, a re-action is produced only by a difference in the amount of light which reaches the different sides of a growing part. The direction, then, of a branch, as far as it is dependent on the action of light, is in proportion to the difference of illumination of its parts; for a greater illumination on one side of a branch has the effect of increasing the cell-growth on the shaded side (hyponasty), and thus the more rapid lengthening of the shaded side results in a curvature and a new direction of the tip of the branch toward the light. The action of light on the roots is exactly opposite (epinasty); i.e., the illuminated part lengthens more rapidly, carrying the growing point away from the light.

Considering the action of the light on the normal development of the branch system, concludes Mr. Fernow, we can better understand how the direction of branches is changed from their original position to the one in which we find them in later life; and we can also understand that the typical branch system of trees must to some extent depend on the greater or less density of foliage. Thus less dense foliaged trees should in general exhibit a more erect habit in their branches; while the shadiest foliage should give the most spreading branch system.

How Some Eskimo Measure.

The ape which (or perhaps whom) Mr. Romanes has succeeded in teaching to count five seems to tread closely on the heels of some of the races of men. In a paper on the Eskimo of Point Barrow, Mr. John Murdoch of the National Museum said, that, like the rest of those peoples, they ordinarily do not use numbers greater than five, but speak of six and all higher numbers as 'many.' Their real numbers are one, two, three, four, five, ten (which means the upper part of the body, namely, the number of digits on the upper extremities), fifteen (perhaps), and twenty (which means 'a man complete,' i.e., all his digits used up). These numbers are almost identical with those used in the other dialects, while the intermediate numbers are quite different, though expressed in a similar manner; that is to say, 'so many on the next hand or foot.'

With such clumsy numerals, arithmetical processes are practically impossible, though they practise a sort of crude addition, arriving at the number of a large series of objects by grouping them together in fives. In counting, the ordinal numerals are used. This is also the same as in the other dialects.

They originally had no standard of dimensions for space, but of late years have learned to use the fathom in trading for cloth, etc.

Time is measured by the sun and stars. For example: the star Arcturus is the seal-netters' timepiece. When he is in the east, dawn is near, and it is time to stop fishing. The year is divided into four seasons, — early winter, winter, early summer, and summer.

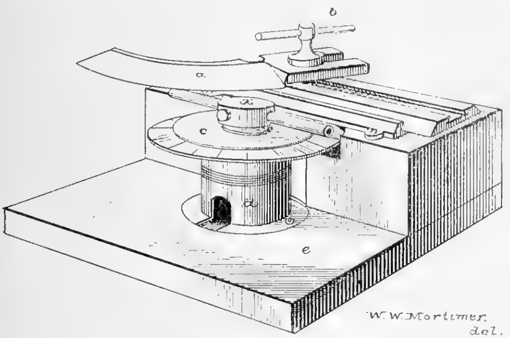
Nine lunar months are known by name. The rest of the year "there *is* no moon, only the sun." They begin to count the moons from the early autumn, the time when the women go off into the little tents to work on deer-skins. The first moon — roughly speaking, October — is "the time for working, i.e., sewing;" November, "the second time for sewing;" December, "the time for dancing" (this is the season of the great semi-dramatic festivals); January, "great cold," or "little sun" (in this moon the sun just re-appears at noon); February, "the time for starting" (on the winter deer-hunt); March, "the time for starting home;" April, "the time for making ready the boats" (for whaling); May, "the time for fowling;" and June, "the time for bringing forth young" (when the birds lay eggs).

They clearly distinguish "to-day," "yesterday," and "to-morrow;" but "day before yesterday" and "day after to-morrow" are the same; and beyond that, all is "some time ago" or "some time hence" (the same word), till it gets to be "long ago" or "by and by."

Then there are no dates in their past or future, except what has happened or is to happen.

Dr. Thomas Taylor's New Improved Freezing-Microtome, adapted to Three Methods of Section-Cutting.

Dr. Thomas Taylor of the Agricultural Department, who several years ago invented a microtome, which was described and illustrated in *Science*, gave the first public exhibition of a new microtome at the last meeting of the Microscopical Society of Washington. The following diagram and description will show the advantages claimed for it. It may also be added that it is simpler, and can be manufactured at much less cost, than the microtomes now generally in use; and, as those persons employed by the government are not allowed to patent inventions made in the line of the work they are engaged in, any microscopist in the country may make and use the instrument here described.



a, curved knife, adjustable at any angle; *b*, binding-screw; *c*, graduated disk, which revolves on stand (*d*) by means of a finely cut screw-thread; *e*, mahogany stand upon which the instrument is secured.

A cork with a central opening is fitted into a descending tube (one inch deep, by one and a half inches in diameter) in the centre of disk (*c*). Cork and tube revolve with the disk. In the central opening is fitted an ordinary stopper or cork, on top of which the object to be shaved may be secured by paraffine or wax.

In order to freeze objects, remove the central cork, and insert the hollow metal box (*x*), a prolongation of which fits into the hollow cork in disk (*c*). Two tubes of metal project from the freezing-box, — one to admit water, the other to allow it to flow out. The water is supplied and carried off by means of rubber tubing attached to the metal tubes, the terminal end of the rubber tube which carries off the water being contracted to control the flow.

In the use of ether as a means of freezing objects for the cutter, remove the plug in front of the freezing-box, and detach the rubber tubing. Apply ether in the usual manner.

ETHNOLOGY.

Tales from Venezuela.

DR. A. ERNST, who has done so much to increase our knowledge of Venezuelan ethnology, has collected a few popular tales, which are very interesting on account of their Tupi and Spanish affinities. The tales are entitled 'Tio Tigre and Tio Conejo' ('Uncle Tiger and Uncle Rabbit'), and all of them have for their subject the superiority of cunning and craft over sheer force. We give here translations of a few of these tales.

"Uncle Tiger had a field of splendid watermelons. He observed that somebody visited his field at night, and stole the melons: therefore he made a figure of a man of black wax, and placed it in the field. At night Uncle Rabbit came, and saw the figure. 'What are you doing there, you black man? Get away!' The figure did not reply. Then Uncle Rabbit went up to the black man and boxed his ears; but his right hand stuck to the wax. 'Let go my hand, or I'll box your other ear!' cried he. When he did so, his left hand also stuck to the wax. Then he knocked his head against the forehead of the figure: his head stuck to it. Then he worked with his hind-legs to get away: they also stuck to the wax, and Uncle Rabbit was caught. Early in the morning Uncle Tiger came, and when he saw Uncle Rabbit, he cried, 'Oho! have we got the thief? Now I'll eat you!' — 'Wait a moment,' said Uncle Rabbit; 'set me free, and I will show you a pit in which two large deer have been caught. You had better eat those.' Uncle Tiger thought, 'Two large deer are better than Uncle Rabbit,' and he set him free. Uncle Rabbit led him to a deep pit, and said, 'Stoop down, and you will see the deer.' When Uncle Tiger did so, Uncle Rabbit pushed him from behind, and Uncle Tiger fell into the pit. Uncle Rabbit, however, ran away as fast as his legs would carry him."

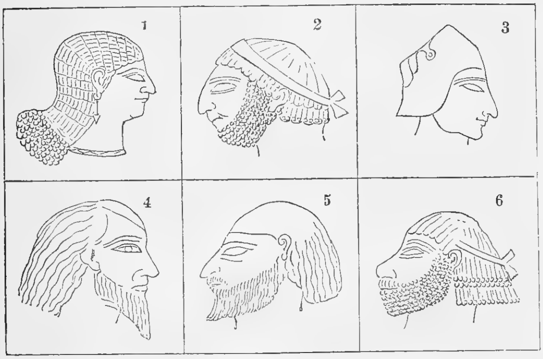
Here is another story: "Uncle Rabbit was very sad because he was so small. He went to God, and wanted to be made taller. God said, 'I will do so, but first bring me a coral snake, a wasp swarm, and a calabash filled with women's tears.' Uncle Rabbit started on his journey, and arrived in a forest where there were many snakes. Walking along there, he said, 'I bet there is room for him, I bet there is room for him!' A coral snake heard him, and asked what his speech meant. He replied, 'The wasps say that there is not room enough for you in this calabash, and I bet that you can get in there.' — 'We will see at once who is right,' said the snake, and crawled into the calabash. When he was in it, Uncle Rabbit at once put the stopper into the opening, and thus the snake was caught. Then he went on, and said, 'I bet there is room for them, I bet there is room for them.' The wasps heard him, and asked what his speech meant. 'Oh!' said Uncle Rabbit, 'the snake says there is not room enough for your swarm in this calabash, and I bet that all of you can get in there.' — 'We will see at once who is right,' said the wasps, and crawled into the calabash. When the whole swarm was in, Uncle Rabbit put the stopper into the opening, and thus the wasps were caught. He next went to a village, and when near the huts he began to cry and lament. Then all the women gathered, and asked the cause of his grief. 'Oh!' said Uncle Rabbit, 'why should I not cry and lament? The world is going to be destroyed to-day, and all of us will perish.' When the women heard this, they began to cry woefully, and Uncle Rabbit filled a calabash with their tears. Then he returned to God. When the latter saw the three calabashes with the snake, the wasps, and the tears, he said, 'Uncle Rabbit, you are more cunning than any one else. Why do you want to be taller? But as you wish it, I will at least make your ears larger.' Saying so, he pulled Uncle Rabbit's ears, and since that day they have remained long."

The Races of the Babylonian Empire.

In a recent number of the Journal of the Anthropological Institute, Mr. G. Bertin publishes an interesting study of the types of man found on Babylonian monuments. One of the most remarkable results of his researches is the proof that the Armenian race of these early times exhibits the same characteristics to be noticed in the modern Armenians (Fig. 3). This is the more remarkable from the fact that at this period the language spoken in Armenia, and illustrated by the inscriptions of Van, is totally different from Armenian, and linguistically connected with Akkadian and Medic. Evidently the Armenian population has, in course of time, acquired a new language, while its physical characteristics survive. Dr. von Luschan has shown that the Turks and Greeks of Asia Minor are of the same Armenian type, and thus the great antiquity of the native population of this region is proved.

Conclusions derived from types represented on ancient monuments cannot be of the same value as craniological researches; the individuality of the artist, the conventionalism of art, and the object of the monument having a ruling influence upon the character of the representations. Captive enemies will not be represented in the same way as a victorious king and his allies. Nevertheless a variety of types may readily be recognized, as the artists undoubtedly represent typical individuals. A few figures from the plate accompanying Mr. Bertin's paper have been reproduced here. It will be noted that the faces are represented in profile, with eyes in full face. Figs. 2, 4, 5, and 6 are of peculiar interest. The persons represented resemble the types of figures on Assyrian monuments showing people of inferior condition. Fig. 2 is taken from an Assyrian monument. The head is small and round, the forehead low and slanting, the cheek-bones high, the lips thin, and the chin

retreating. In many of these figures a marked prognathism may be observed. The nose is often large, and does not appear to have ever been flat and wide, as among the Tatars; hair and beard are frizzy; the stature, short. In some parts of Babylonia this type seems to have formed the great mass of the population. According to Mr. Bertin's theory, this people was the 'ground race' of western Asia, and he goes so far as to identify it with the European prehistoric races, which are by many authors believed to be of Berber origin. He adds, "An important point to notice is that this race is everywhere found in an inferior social position, and it was equally so in the remotest age. Nowhere did it rise to the rank of a dominating or ruling race, but everywhere it accepted the yoke of the conquering tribe invading its land. It is the race of the land, and accepts every new master with a passive obedience. This explains why this race has no language of its own, for it accepts willingly



that of its masters." The author believes that this people was conquered by Akkadians and by Semites, and that the mixture of these races, with the addition of some Armenian blood, resulted in a population showing the various types found on the monuments.

The study of the west Asiatic and Egyptian monuments from an anthropological and philological point of view has recently yielded most interesting results, and opened entirely new views of the early history of the ancient world. The intercourse between the various peoples, and their mutual influence upon each other, were so important, that a comprehensive and comparative study of all these numerous peoples is necessary to reach satisfactory results. The theories of Mr. Bertin are suggestive, and well worth a careful consideration; but they must be verified by a comparative study of the monuments of other races, and, what is still more important, by exact anthropometric researches.

ELECTRICAL NEWS.

Submarine Boats.

THERE are few books that have been read with so much pleasure by young and old as Jules Verne's 'Twenty Thousand Leagues under the Sea.' The submarine boat 'Nautilus,' propelled by electric motors, — very complicated ones, if the writer remembers the picture correctly, — the electricity furnished by powerful batteries, was able to move at a wonderful speed beneath the ocean at the will of her mysterious commander.

The folly of one generation is the wisdom of the next, and to-day we are in all seriousness trying to faintly rival the vessel of Captain Nemo. The boats that are being built are for torpedo purposes, and are neither large, nor do they attain a very high speed, nor can they remain long beneath the water; but we look for a steady improvement in their performance, and we believe that some day such vessels will be of practical use to mankind. The great difficulty in submarine propulsion is the obtaining of some propelling agent that can be used beneath the water. Hand-power was first tried, and later compressed air and carbonic acid have been employed. For automatic torpedoes, such as the Whitehead or Lay, the two latter agents are fairly successful, but the amount of energy that can be practically stored by either means is too small to be of use in a real submarine boat.

The history of the early experiments in submarine navigation is the history of disaster. There are stories of partial successes, but the sequel is usually tragic. A successful submarine boat is said to have been made by a Chicago shoemaker, who was in the habit of going out in it and spending his afternoons in the bottom of the lake. One evening he failed to return, and, as he had not communicated the plans of his boat to any one, his experience is lost to us. The writer remembers, in the war between Chili and Peru, that a submarine boat was built by the latter government to destroy the Chilian fleet, at that time blockading Callao. It was to have been run by compressed air, and was calculated to attain a speed of four miles an hour. An unfortunate miscalculation resulted in the weight of the vessel being greater than her displacement; and, on being launched, she immediately went to the bottom, where, owing to the characteristics of her builders, she was allowed to remain. During the late war a number of experiments were tried with submarine torpedo-boats; but, excepting in one case, they resulted in failure.

There is no inherent impossibility in navigating boats beneath the surface for any length of time. The atmosphere can be purified and its oxygen renewed by chemical means, and the depth that can be attained depends only on the ability of the boat to resist the enormous pressures to which it is subjected at any considerable depth. The distance beneath the surface can be regulated in a number of ways, for the density of the water is practically the same at any depth. The only drawback has been in the difficulty of obtaining power. In the last few years electricity has promised to remedy this.

The latest and largest submarine boats are being tried in Toulon and at San Fernando respectively. Let us first describe the French boat, the 'Gymnote.' She is driven by an electro-motor coupled directly to the armature shaft, and supplied with electricity from storage-batteries. The motor absorbs 52 electrical horse-power at 280 revolutions a minute. The total weight of the motor is about two tons. The electric energy is furnished by a battery of 564 storage-cells of the Commelin-Desmasures-Baillehache type, described in this journal (No. 305). Each of the cells weighs about forty pounds, making over ten tons for the weight of the battery. They have furnished 58 horse-power for four hours. The experiments made on this set of cells show that to store one horse-power of energy requires about eighty pounds, while energy can be taken out from them at the rate of a horse-power for four hundred pounds. The 'Gymnote' has been tested in the roadstead of Toulon to determine her behavior, but so far the experiments have only shown how long she can safely remain beneath the water. Half an hour is the longest time as yet, but it is hoped that the time of submersion will be considerably increased. What the speed of this vessel will be, how easily she can be controlled, and what depth she can safely reach, are questions yet to be determined.

The boat being tested at San Fernando, 'Le Peral,' has been constructed from the designs of Lieut. Isaac Peral of the Spanish Navy. It is about seventy-two feet long, by nine feet and a half at its greatest diameter. It is driven by five electro-motors, — two of twenty, three of nine horse-power, — furnished with current from 600 cells of storage-battery. No experiments have been made on this boat, but it is calculated that she will have a speed of twelve knots at the surface, and of ten knots when half submerged. It is also calculated that she can remain below the water for two hours without requiring a fresh supply of air.

Germany is not behindhand in these experiments, and has built at Kiel a boat one hundred and twelve feet long. Its immersion is regulated by two vertical screws driven by a six-horse-power motor. What the propelling power is, and what its performance may be, we have no data that will enable us to guess; but that the motive power is furnished by electricity there can be little doubt.

These three boats, the most ambitious yet constructed and the most probable of success, contrast but meanly with the 'Nautilus.' The immense size of the latter, her speed of fifty miles an hour, the depths to which she descended, will be for many years, if not always, the imaginings of a story-writer, with no practical counter-

part. But that we shall at no very distant day be able to explore the shallower parts of the ocean, and recover some of the enormous wealth that lies hidden in wrecked vessels, there is little doubt. Already powerful electric lamps are used to illuminate the oyster-beds for the pearl-divers, being lowered to any depth required; and it is easy to predict that before long some submarine boat, propelled and powerfully lighted by electricity, will be searching for the wrecks of galleons and treasure-ships. The things most needed are faith in the success of the plan, daring, money for equipment and experiment, and, what is so often needed for a new application of electricity, a more perfect storage-battery.

ANOTHER NEW STORAGE-BATTERY. — Patents have just been granted to Louis Duncan of Baltimore for an improvement in secondary batteries. A great objection to the present battery lies in the fact that the inactive support-plate is heavier than the active material, — only one-third to one-fourth the total weight of plate is active in the ordinary cell, — while the limited surface prevents a heavy discharge-rate. With ordinary lead supports, an increase in surface causes an increase in the local action and depreciation of the cell, while any decrease in the thickness of the support also decreases the life of the cell. In this patent it is the intention to get a large surface, and a large proportion of active material to total weight, without decreasing the life of the cell. Broadly the idea is to coat the support-plate — a thin sheet of copper, washed with lead, in one of the claims — with a very dense layer of an oxide of lead, deposited on it from a solution of litharge in caustic potash, by means of a weak electric current. The deposit is so dense that it completely shields the sheet underneath from contact with the liquid: so, when the plate is put in sulphuric acid, there can be no local action between this coating and the lead beneath. By increasing the strength of current in the solution of litharge, the character of the deposit completely changes, becoming porous, and having a considerable electrical capacity. The positive plate, then, has four layers, — first, an outer active layer of peroxide of lead; second, a layer of dense peroxide that has no capacity; third, a thin coat of lead; and, lastly, the copper plate. Between the first and second layers there is no local action, because they are of the same chemical constitution; between the second and third there is no local action, since there is no liquid between them, while of course there is no action of the lead on the copper. We have no data as to any actual results. If the protective action of the dense peroxide claimed in the patent is really perfect, then a cell can be made with an immense surface for a given weight, and an excellent capacity. Such a cell should be of the greatest value, especially in traction-work; but no opinion as to the practical value of the cell is worth any thing unless supported by experiments carried on for a considerable time.

UNDERGROUND CONDUITS. — A meeting of the committee on underground conduits and conductors, of the National Electric Light Association, was held at the association headquarters, 16 East 23d Street, New York, on Tuesday, Dec. 11. The meeting was called to order at 2 o'clock P.M. by Mr. E. T. Lynch, jun., chairman. A preliminary discussion as to the present state of the art was entered into by the members present, and there seemed to be a very general impression that one of the most important things at present was to ascertain more fully and accurately than had heretofore been done, just what has so far been accomplished in this country touching upon the undergrounding of arc-light conductors. Several plans for accomplishing this were discussed, and the committee adjourned until Monday, Dec. 17, when definite plans for carrying out the work of the committee will be consummated. The members of this committee are E. T. Lynch, jun., chairman; F. B. Crocker; Gen. C. H. Barney; and Walter C. Kerr.

NOTES AND NEWS.

OBSERVATIONS have been made in India, South Africa, and Australia, which led to the conclusion that certain carboniferous rocks were formed by the action of ice. Conglomerates were found which contain large bowlders of various materials, some of which have characteristic scratches and striæ. Recently A. Derby found similar rocks in southern Brazil. The general appearance of these rocks is much like those of India and South Africa, and it seems probable that their origin is due to the same causes which formed the latter. So far, no striæ have been observed; but, as the region has not yet been investigated thoroughly, their existence is quite possible. The wide distribution of strata of this character is an undoubted proof that their origin is due to a general, probably a cosmic, cause; and among these, glacial action seems to be the most probable.

— It will be remembered that a number of elements had atomic weights which seemed not to be in correspondence with the demands of Mendelejeff's periodical system. Recent experiences have shown that these discrepancies were due to inaccurate determinations of atomic weights. K. Seubert has proved that the last of these discrepancies is due to the same cause. The theory demanded that the atomic weight of osmium be smaller than that of iridium, while former experiments gave the opposite result. Seubert has shown that the determinations which had been made by Berzelius and Frémy were inaccurate. He finds the atomic weight of osmium to be approximately 191, while that of iridium is 192.5.

— Hypnotism thrives in Washington. Two gentlemen interested in psychological studies, Mr. W. A. Croffut, executive officer of the Geological Survey, and Gov. N. J. Colman, commissioner of agriculture, give occasional *soirées hypnotiques*, at which they hypnotize numbers of "sensitives." During some recent experiments by Mr. Croffut, two young ladies, temporary victims of the hypnotic hallucination, were taken into an imaginary picture-gallery and there left, while the operator turned his attention to a young man who was engaged in the dangerous pastime of catching crocodiles. On returning to the ladies, Mr. Croffut found that he could not make them cognizant of his presence. They did not appear to see him, or hear his voice, and when he stood directly in front of them they took no notice of him whatever. It was a new and somewhat alarming experience, and a quarter of an hour passed before the hypnotizer re-established his domination, and brought them back from the land of dreams.

— Prof. J. P. Lesley has sent out a few final proofs of the first signatures of his report on the fossils of Pennsylvania, in the form of a dictionary, for the convenience of students and collectors of fossils in that State. It will be useful to them, and perhaps to others; but Professor Lesley claims no scientific merit for it, excepting that it contains a small number of new species discovered in the State collections, and named and figured by Mr. G. B. Simpson, in consultation with Prof. James Hall of Albany. The book itself is a compilation, which Professor Lesley made from various sources, mostly classical, and much of it old, and of difficult attainment by students of the present day. In the preface, when printed, all these sources will be fully recited. The book is going through the State Printing-Office at Harrisburg, will be bound in two volumes, and each volume distributed, when bound, separately.

— Mr. George F. Kunz, Hoboken, N.J., will purchase or take in exchange meteorites for fine crystallized or rare minerals. Intact falls, all the pieces of a fall, and newly found and undescribed ones, are especially desired; also aboriginal objects made of jade, jadeite, chlormelanite, pectolite or other allied minerals, or new occurrences of same; facts in regard to and specimens of American pearls, and American amber from all localities, especially if containing enclosures of wood, vegetable, or other living matter; gold and silver ornaments from the United States, and data concerning them. He is also desirous of securing the gem writings of certain ancient authors.

— It has long been known that rails of tracks in actual use oxidate much slower than those of dead tracks, but so far no satisfactory explanation has been found. W. Spring, in the Bulletin of the Royal Belgian Academy, shows that this is due to the formation of a coating of magnetic oxide of iron under the influence of humidity and pressure. In order to prove the correctness of this view, Mr. Spring has brought moistened rust and a clean plate of iron under a pressure of from a thousand to twelve hundred atmospheres, which corresponds to that of the wheels of a locomotive of a thousand hundredweights. He found that the rust-powder had penetrated the iron, and formed a coating of magnetic oxide.

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CONTENTS:

THE RECENT NEWS from the Equatorial Province shows that the Mahdi's successor, Abdullah, has as strong a hold upon the Mohammedan peoples of Egyptian Sudan as had his predecessor. While for some time the impression prevailed that the fanaticism of these tribes had abated, the attacks upon the English at Suakin proved at least that the Mahdi still swayed over the region from Khartum to Berber. It will be remembered that since the unexplained retreat of the Mahdi from the Equatorial Province Emin Pacha had been comparatively undisturbed, but about the end of last year rumors of a renewed attack reached the coast. It was stated that in March the Mahdi contemplated sending four thousand men on four of Gordon's old steamboats up the Nile, in order to attack Emin. If Osman Digma's message to the English be true, and not a trap, this expedition has been successful, and Emin has at last succumbed to the powerful religious movement which centres in Khartum, and with him Stanley, who had joined hands with him since November last year; and both would share the fate of the unfortunate Lupton and Slatin. It is said that a dervish named Omar Saleh returned some months ago from a successful raid into the upper valley of the White Nile. He seems to have encountered Emin in October at Lado, and captured him and Stanley. Undoubtedly Emin would not have been able to withstand the attack of an expedition like the one referred to, and from his former behavior it does not appear probable that he would have retreated south-eastward. While the news is quite probable and credible, we may still maintain a faint hope that it has been merely invented to prevent the English from energetic action at Suakin. It has been stated before that the only real means of helping Emin would have been an attack upon the Mahdi from the north; but this, of course, was out of the question, since the English had given up the Sudan. Stanley's expedition was a failure, as, on account of his long delay and the destruction of his rear guard, he was unable to supply Emin with a sufficient amount of ammunition and trustworthy men. Neither would the planned German expedition have been of great account in a war with the Mahdi, as it would hardly have succeeded in opening a route to Emin, which latter would have been the only means of maintaining the rule over the Equatorial Province.

THE SELECT COMMITTEE of the Senate of the Dominion of Canada, appointed to inquire into the resources of the great Mackenzie basin, has collected a vast amount of information, which has recently been published, and of which we give abstracts in another place. Although much of the information contained in this report is too vague to be of value, the greater part is founded on sound reports of well-informed men, and our knowledge of the natural productiveness of this vast area is greatly increased. In weighing the economic value of the area under discussion, it must be considered that the northern limit of vegetable products and of pasture-land does not coincide with the northern limit of profitable agriculture and stock-raising. In the report of the committee, the analogy of those parts of Russia near the northern limit of possible agriculture is frequently emphasized; but it must be borne in mind that the economic conditions of America and Russia are fundamentally different. Up to this time, agriculture in the new West is founded on extensive culture, no attempt being made to make the soil yield the largest possible continuous returns by intensive culture. At the same time a great portion of the immigrants do not settle there to make a living, but with the prospect of becoming wealthy. In Canada as well as in the United States a great number of settlers in the prairie territory are at the same time land-speculators. For these reasons the limit of agriculture will not approach as closely the limit of possible agriculture as it does in Russia, where a native population, loving the native soil, makes a hardy living. It is only when the economic conditions of the Western States shall have undergone a complete change that these northern districts, which are able to support a population, will become settled.

BACTERIA.[1]

AS director of the Hoagland Laboratory, I take advantage of this opportunity to congratulate Dr. Hoagland, the city of Brooklyn, and my present audience, upon the completion of this building, devoted exclusively to scientific research, and instruction in certain departments of biology; viz., in physiology, pathology, histology, and bacteriology. Indeed, I may extend my congratulations much further; for such a laboratory as this is a centre from which the rays of scientific learning will radiate to all parts of this great country, and which cannot fail to exercise an important influence upon the progress of knowledge in these fields of research. I do not know when Dr. Hoagland first conceived the idea of building and equipping a laboratory devoted to these fundamental branches of medical science, but it is now nearly two years since he made his first visit to Baltimore for the purpose of inspecting the laborato-

[1] Portion of a lecture delivered by Dr. George M. Sternberg at the Hoagland Laboratory, Brooklyn, Nov. 17, 1888.

ries connected with Johns Hopkins University. These had been recently built under the direction of professors familiar with the best laboratories of Europe, and Dr. Hoagland could not have found in Great Britain or on the continent any better models from which to make his plans. We are indebted to him not only for the money required to build and equip such a laboratory as this, but for his constant personal supervision and attention to details, from the first draughts of the plan until the moment of completion. I have been consulted from time to time; and the first visit to Baltimore was followed by several others, in which Dr. Hoagland carefully noted all of those minor details which go to make a laboratory complete and comfortable. The result is, as you see, a building thoroughly suited to the purpose for which it was designed, and which also, from an architectural point of view, is an ornament to the "City of Churches."

I have also been consulted with reference to apparatus; and we have here to-day, or on the way from Europe, every thing that occurred to me as essential for the equipment of the laboratory. The library has also been most generously provided for, and it is the intention to have upon its shelves not only standard books of reference, but, so far as possible, complete files of the English, French, and German periodicals relating to those branches of research to which the laboratory is devoted.

No one appreciates the advantages of such a laboratory as this more than I do, and I would be happy if circumstances made it possible for me to go into camp here during the balance of my working life. A pioneer in this country in the pursuit of bacteriological studies, I have seen to open up before me a most inviting field of research, presenting a multitude of important questions awaiting solution by the experimental method, and I have learned by experience how little can be accomplished in the absence of suitable laboratory facilities.

I have felt from the first that this country ought to take some part in the investigations relating to the etiology of infectious diseases, which have resulted, within the brief period of twenty years, in discoveries which will make this the most famous epoch in the history of scientific medicine. There can be no question that we have plenty of men who have the necessary intelligence and zeal to make them leaders in this or any other department of scientific investigation, but we have sadly lacked just those facilities which are furnished by this laboratory; for intelligence and zeal cannot take the place of training and a knowledge of the methods of research which have been perfected by the patient labors of others. The young man who starts out to make discoveries without such training is like the old farmer, who, after churning for years with an old-fashioned up-and-down, dash-churn suddenly conceives the idea that a churn with a crank would be an improvement, and applies for a patent, only to find that the same idea had occurred to thousands before him, and that patents have been granted on crank-churns of every conceivable form.

Our library takes the place of the patent-examiner. And when the trained investigator desires to follow any particular line of research, his first step is to find out what others have done before him; his second, to consider whether known methods and instruments will answer his purpose, and, if not, to devise and test such methods of research as occur to him.

With this brief introduction, permit me to proceed with the special subject upon which I am to address you.

Leeuwenhoek, the father of microscopy, first discovered the minute organisms known as bacteria in putrid water and in tartar from the teeth; but it was not until the present century was well advanced that the true character of these micro-organisms, and the important part which they play in the economy of nature, were recognized. We know now, that although certain species are pathogenic for man and the lower animals, and give rise to fatal infectious maladies, the bacteria as a class are essential for the continued existence of the higher plants and animals upon the surface of the globe and in the waters of the ocean. It is their function to return to the earth and the air those elements and simple compounds which go to make up the complex organic structures which enter into the composition of the tissues of living plants and animals. So soon as the physiological processes upon which vitality depends have ceased, either from external or internal causes interfering with the integrity of organs essential to life, these universa destroyers commence their work, and those putrefactive changes are inaugurated which result in the disintegration of animal and vegetable tissues. It is evident, that, if no such disintegrating agency existed, the surface of the earth and the waters of the ocean would soon be encumbered with dead plants and animals, and the course of animate nature would be arrested, both by occupation of available space and by exhaustion of nutritive material.

These processes of decay, which in animal bodies exposed to the air occur so promptly, under favorable conditions as to temperature and moisture, are going on continuously in the upper layers of the soil, where the roots of annual plants, and the organic material turned under by the plough of the farmer, must be reconverted into elementary substances which can be appropriated by growing plants. In the ocean the same thing occurs, — the myriads of fish and other living creatures which perish every day are quickly invaded by these omnipresent micro-organisms, and undergo disintegration.

The question may be asked, 'What, then, becomes of these putrefactive organisms, and what prevents them from taking full possession of the waters of the deep?' Like other living organisms, they have their life-cycle, and perish at the end of a given period, and, like other living organisms, their multiplication is limited by the amount of available material. Moreover, they serve as food for a multitude of micro-organisms a little higher in the scale of existence, and especially for the *Infusoria*.

Under this name — *Infusoria* — the older naturalists included all of the minute unicellular organisms observed by them in putrefying infusions. At present this name is applied only to unicellular animal organisms, and among the unicellular vegetable organisms the bacteria have been differentiated from the *Palmellaceæ*, the *Saccharomycetes*, and the reproductive elements of the higher *Algæ*, all of which were formerly confounded under the general name of *Infusoria*.

Ehrenberg (1838) was the first to separate the bacteria as a distinct class of organisms, under the name *Vibrioniens;* but he did not include the spherical bacteria — micrococci — in this class, and did not recognize the vegetable nature of these micro-organisms. In his family of *Vibrioniens* he included four genera, which he defined as follows: 1. *Bacterium* (filaments linear and inflexible); 2. *Vibrio* (filaments linear, snake-like, flexible); 3. *Spirillum* (filaments spiral, inflexible); 4. *Spirochæte* (filaments spiral, flexible).

Dujardin (1841), in his 'Histoire Naturelle des Zoophytes,' still preserved the family of *Vibrioniens* of Ehrenberg among the *Infusoria*, and it was not until 1859 that the eminent French physician Davaine clearly recognized the bacteria as vegetable organisms nearly allied to the *Algæ*, — a view which was subsequently adopted by the distinguished German botanist Cohn, and which is pretty generally accepted at the present day. Some botanists, however, insist upon the affinities of the bacteria with the microscopic fungi, and it is this view which has induced Nägeli to describe them under the name of *Schizomycetes*, or fission fungi. The chief ground for this classification is found in the fact that the bacteria, like the *Mucorini*, are destitute of chlorophyl.

The vegetable nature of yeast-cells had previously (1836) been recognized by Cagniard-Latour and by Schwann; and the vitalistic theory, as regards the alcoholic fermentation, was clearly defined and established experimentally by the last-mentioned author in 1837. This theory was subsequently extended by Pasteur to processes of fermentation and putrefaction in general; and, in the face of much conservative opposition, the distinguished French *savant* finally demonstrated that in the absence of these living ferments organic liquids may be kept indefinitely without undergoing change; and that contact with the atmosphere does not induce these changes, as had been generally supposed, but that when they follow such contact it is due to the presence in suspension of living micro-organisms.

Hoffmann (1843) had previously shown that calcined air admitted to a boiled organic liquid does not cause putrefaction, and in 1854 Schroeder and Von Dusch showed that the suspended particles in the atmosphere may be removed by passing air through a cotton-wool filter.

For a time the advocates of abiogenesis supposed that they had

demonstrated by experiment that micro-organisms may develop in an organic liquid sterilized by heat; but Pasteur showed that the boiling temperature does not destroy all germs, and that to insure sterilization of a neutral or alkaline medium a temperature of 110° to 112° C. is required. The same *savant* first recognized the fact that this failure to sterilize organic liquids by boiling at the ordinary barometric pressure was due to the presence of reproductive bodies, which he described under the name of 'brilliant corpuscles,' 'germs,' 'conidia,' etc. These spores had previously been seen by Perty in 1852 and by Charles Robin in 1853, but it was not until 1876 that their mode of formation and true function were definitely established by the German botanist Cohn. In the same year Koch published in Cohn's *Beiträge zur Biologie der Pflanzen* his admirable memoir, 'Die Aetiologie des Milzbrandkrankheits,' in which he showed that endogenous spores are produced, under certain circumstances, by the anthrax bacillus, and that these are true reproductive bodies. In 1881 the same author published in the *Mittheilungen aus dem Kaiserlichen Gesundheitsamte* his disinfection experiments, in which these spores served as the test of the disinfecting power of heat and of various chemical agents. These experiments showed that dry heat was very much inferior to moist heat for the destruction of these bodies, and that when perfectly dry they resisted for several hours a temperature of 20° C. above the boiling-point. To insure their destruction, a temperature of 140° C., maintained for at least an hour, was found to be necessary. When, however, the spores were immersed in boiling water, or in steam given off from the same at the ordinary pressure of the atmosphere, it was found that a few minutes sufficed to destroy the vitality of these spores.

The demonstration that the atmosphere constantly contains in suspension the living ferments which cause putrefactive and fermentative changes in organic liquids led to the belief, still entertained by many who are not familiar with our bacteriological methods, that the slightest exposure must insure the entrance into such a liquid of these ubiquitous germs.

Pasteur first showed that the liability to contamination by a brief exposure to the air is by no means so great as had been generally supposed, and that, as a matter of fact, a putrescible liquid rarely becomes infected by such exposure as occurs in the ordinary laboratory operation of removing the cotton air-filter for the purpose of inoculating a culture. This is now a matter of every-day laboratory experience; and the fact, also demonstrated by Pasteur, that upon the surface of objects, and especially in accumulations of dust, these living ferments abound in great numbers, is now generally recognized.

Up to the time of Cohn, botanists had paid but little attention to the minute vegetable organisms under consideration; and but for the discovery that some of them invade the human body as parasites, and thus give rise to fatal forms of infectious disease, it is probable that we would still be ignorant of their real characters. The earlier botanists had no conception of the great number of species existing, — species which we now know are in many instances as well defined, and apparently as permanent in their characters, as is the case with plants higher in the scale of living things. The older botanists generally adopted the view that these low organisms are polymorphous, and that there are but a small number of distinct species. Indeed, until the illustrious German bacteriologist and physician gave us a reliable method for isolating the various forms which are commonly associated in putrefying infusions, it was impossible to determine what relation the little spheres, rods, and spiral filaments revealed by the microscope might bear to each other. Since Koch's methods have been employed by industrious investigators in all parts of the world, we have commenced to learn something of the bacterial flora; and it is apparent that the number of distinct species is enormous, — comparable, for example, with the number of well-defined species of diatoms, desmids, or other classes of *Algæ* higher in the scale. This flora is no doubt different in different parts of the world, although some species are widely distributed, and we may expect to discover many new forms when bacteriologists extend their researches to distant portions of the globe, and especially in the tropics. Already extended researches have been made, especially in Germany, with reference to the bacterial flora of the soil, of streams and wells, and of the atmosphere; but this line of research may be said to be still in its infancy, and what has been done only serves to indicate the extent of the field and the amount of work which remains to be done before our knowledge will be complete. The same may be said of the bacterial flora of the intestine of man and of the lower animals. Here we have not only to determine the constant species, as distinguished from the accidental, and in some cases no doubt pathogenic forms, but we have also to determine the physiological *rôle* of each constant form; for we can scarcely doubt that these commensals of man, which help to disintegrate the organic pabulum introduced into the alimentary canal, and give rise to the formation of a variety of chemical products, some of which are known to be toxic, play an important part in the economy of the individual.

With the methods now at our command, these questions, and those relating to the physiological characters of pathogenic species, are open to investigation. But let me warn the young bacteriologists of to-day not to plume themselves too much upon the scientific achievements which await them in the application of these methods, and to remember that the serious errors which in the past have been made by many of the pioneers in this field of investigation were in many instances due, not to an inferior degree of intelligence or a less earnest desire to get at the exact truth, but to the difficulties which they encountered in a new field of investigation, in which satisfactory methods of research were not yet developed.

The great impetus which bacteriological studies have received since the introduction of Koch's plate-method and the use of solid culture-media, is shown by the recent literature of the subject. Prior to this date (1881) the number of active workers in the field was small, and much of the work done had little scientific value from our present point of view. Morphological differences were the chief reliance for differentiating species, but we now know that such distinctions are entirely unreliable. Many species which have important and permanent physiological characters, which serve to distinguish them in a definite manner, are practically identical in their morphology. Thus, for example, no bacteriologist would attempt to decide, by a microscopical examination alone, whether a coccus obtained from the pus of an acute abscess was the staphylococcus aureus, citreus, or albus; but the growth upon a solid culture-medium would decide the matter by the characteristic color of the mass developed about the point of inoculation. A great part of the work to be done in bacteriological laboratories consists in this differentiation of species, and in defining in an exact manner the biological characters of each, including mode of growth in various media, resistance to chemical agents and to heat and cold, pathogenic power, etc.

As indicating the progress in this department of science and the character of the work already done, I propose to make a brief analysis of the literature of the subject. In a bibliography at hand, which is quite full without being complete, I find reference to 41 papers published prior to the year 1860. Of these, 7 are in German, 31 in French, and 3 in English. During the decade from 1860 to 1870 the same bibliography gives the titles of 55 papers, of which 8 are in German, 43 in French, 3 in Italian, and 1 in English. The following decade, 1870 to 1880, shows a very greatly increased activity in this field of research; and among the titles given we have in Germany papers by Buchner, Billroth, Cohn, Eberth, Frisch, Hiller, Klebs, Koch, Letzerich, Nägeli, Orth, Pragmowski, Weigert, Wernich, and others. In France the most prominent names during this period are those of Arloing, Cornevin, and Thomas, Béchamp, Paul Bert, Bouley, Chauveau, Colin, Davaine, Donné, Felz, Miquel, Pasteur, Van Tieghem, and Toussaint. In England the most important contributions during the same period were by Bastian, Beck, Cunningham, Dallinger, Dougall, Klein, Lewis, Lister, and Sanderson. The total number of titles included in my bibliography is 329, of which 122 are German, 121 French, 57 English, and 9 Italian. From this time the interest in this field of investigation, as shown by the literature in which experimental investigations are recorded, has very rapidly increased. My bibliography gives the titles of 92 papers published during the year 1881, of which 27 are in German, 45 in French, 16 in English, and 4 in Italian.

Passing over the years 1882, 1883, and 1884, I take from the valuable 'Jahresbericht' of Baumgarten, first published in 1885,

the following figures, which, for convenience, I have arranged in tabular form: —

TITLES OF PAPERS RELATING TO BACTERIOLOGY.

Year.	German.	French.	Italian.	English.
1885	119	19	5	5
1886	291	58	44	23
1887	483	124	66	55

No doubt the great increase in the number of papers during the year 1887 is in part due to the fact that the bibliography is more complete, and many papers of minor importance are included. It must be remembered, also, that quite a number of the Italian bacteriologists, and some of the students from this country who have pursued their bacteriological studies in Germany, publish their papers in the German language.

It will be seen from what has been said, that while the French took the lead in researches in this department prior to 1870, and during the following decade (1870–80) contributed about the same number of memoirs recording experimental work as the Germans, the last-mentioned nation is now far ahead not only as regards the number of workers in the field, but, I may add, in the scientific value of the work done; while the number of workers in this field of investigation is even less among English-speaking people than among the Italians. I am not willing to admit that this difference is due to race characteristics alone, although the Germans are noted for the thorough way in which they devote themselves to the elucidation of scientific questions by the experimental method. The great activity in France during the period included between the years 1860 and 1880 was without doubt largely due to the influence of Pasteur, who, by his experimental work and his writings, did more than any other man to establish the fact that the minute organisms, which prior to his time had received so little consideration, are important factors in the economy of nature.

In the ante-Koch epoch there was no name in Germany to compare with that of the illustrious French *savant*; and if, from our present point of view, we can point to certain errors of inference, due to the imperfect development of bacteriological technique, these cannot be held to constitute a serious blemish upon the brilliant scientific record of Pasteur. Where are the pioneers who have never followed a false trail? The true distinction of the man of science is that he renounces his own errors as soon as he is convinced that he has made one.

Among the pioneers in bacteriological researches in France, there is one who, next to Pasteur, is entitled to special consideration. I refer to the distinguished physician and scientist, Davaine, whose first paper upon the anthrax bacillus was published in the *Comptes Rendus* of the French Academy in 1863. Certainly the work of Davaine, of Chauveau, and of Toussaint may be compared favorably with that of the German physicians, who contributed most largely to the literature of our subject before the time of Koch.

The discovery by Obermeier, in 1873, of the spirillum of relapsing fever was a notable event in the history of bacteriology, and at once attracted the attention of physicians in all parts of the world to this class of micro-organisms; and it is to physicians, rather than to the botanists, that we owe the rapid development of our knowledge of these minute plants.

A great impetus was given to bacteriological studies in Germany by the introduction by Weigert (1877) of the aniline dyes for staining these micro-organisms.

Koch, in referring to this new method in a paper published a few months after Weigert's first publication regarding it, says that "the aniline colors are retained by micro-organisms with such intensity and with such rapidity, that we may consider these colors re-agents for distinguishing the bacteria from crystalline deposits, or amorphous material of any kind, from fat drops or other corpuscles of small dimensions." From this time these dyes have been our main reliance for differentiating the bacteria from organic and inorganic granules which often resemble them closely in form, and for demonstrating their presence as parasites, in the blood and tissues of animals, in the infectious maladies.

Dr. Robert Koch, who is now generally recognized as the foremost bacteriologist of the world, published his first papers during the years 1876 and 1878, in Cohn's *Beiträge zur Biologie der Pflanzen*. In 1878 his 'Untersuchungen ueber die Aetiologie der Wundinfectionskrankheiten' appeared. These publications marked him at once as a master in experimental investigations, and as a most careful and reliable observer.

Schroeter, in 1872, had made use of slices of boiled potato for the cultivation of chromogenic bacteria, but the method of cultivation in solid media was first described by Koch in Vol. I. of the *Mittheilungen aus dem Kaiserlichen Gesundheitsamte*, published in 1881. This method, together with his plate-method of isolating bacteria, is the foundation-stone upon which the bacteriology of the present day has established itself; and since the road has been pointed out numerous workers in all parts of the world have hastened to explore the previously unknown mines of truth in this important and attractive department of biology.

There are to-day bacteriological laboratories not only in many of the large cities of Europe, from Russia to Spain, but also in a number of the principal cities on this side of the Atlantic. During my recent visit to the City of Mexico, I found a complete equipment of Koch's culture apparatus, and of the apochromatic objectives of Zeiss, in the laboratory of Dr. Carmona y Valle, and in Havana a similar outfit in the laboratory of the 'Cronica Medica,' under the direction of Dr. Santos Fernandes.

The rapid progress of bacteriology in Germany has been due not alone to the epoch-making achievements of Koch, but also, to a very considerable extent, to the enlightened policy of the government. Koch was called to Berlin as soon as his merit was recognized, and his work was carried on in the laboratories of the Imperial Board of Health, where he had the assistance of those medical officers of the German army whose names stand only second to his in the record of valuable work done in this department of science. I refer, of course, to Loeffler, to Gaffky, and to Wolffhügel; and to these associates in his earlier researches may be added the names of Plagge and of Weisser, who have been with him in his new laboratory.

If during the past ten years we had also had a well-equipped laboratory, under proper direction, at the seat of government, does any one doubt that men could have been found in the medical corps of the army and of the navy who would have done work in this department of scientific research which would have been creditable to us as a nation?

Certainly it is not creditable that we, as a nation, have contributed so little to the progress of knowledge in this direction. Let us hope, however, that we are entering upon a new era. Here in Brooklyn private munificence has provided the means of research which the national government should have provided long since; and here, at least, the fault will rest with the profession, if active workers are not found to avail themselves of the facilities provided for making original researches in bacteriology, in physiology, and in experimental pathology.

Another important landmark in the progress of bacteriology and of scientific medicine is the discovery of the tubercle bacillus, and the demonstration that it is the specific etiological factor in the causation of tuberculosis. As you well know, we are also indebted to Koch for this discovery, which was first announced in the *Berliner klinische Wochenschrift* in 1882.

[Having referred briefly to some of the principal facts relating to the history of the subject, Dr. Sternberg occupied the remainder of the time during the lecture in giving an account of the morphology of micro-organisms.]

PROF. WILLIAM H. PICKERING has succeeded in detecting a number of new nebulæ by means of photography. The region surrounding the nebula of Orion was selected for these experiments, and from the results the author concludes, that, by photographing the entire sky, four or five thousand such objects may be discovered. Only in case the large nebula of Orion should prove to embrace all the new nebulæ in its limits, this proportion would not hold good. The experiments show, however, that the method is well adapted to verifying and completing our catalogues of stars.

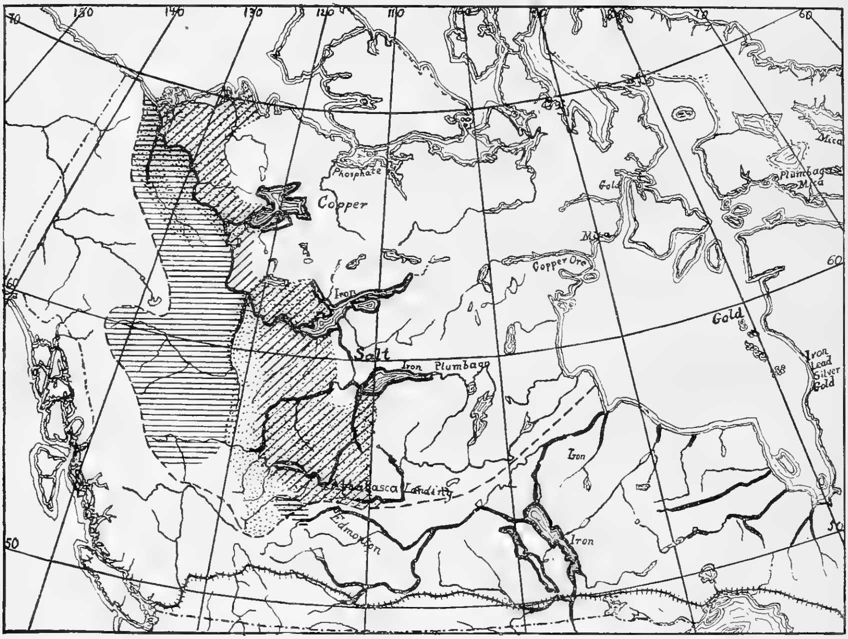
THE GREAT MACKENZIE BASIN.

THE select committee of the Senate of the Dominion of Canada, appointed to inquire into the resources of the Mackenzie basin, has made its third report, which embodies a vast amount of information. The report is accompanied by a series of valuable maps, on which the extent of navigable waters and the distribution of mineral and other products of the country have been laid down. From these maps we have compiled the accompanying sketch-maps, which give a comprehensive review of the results of the committee's investigations.

One of the remarkable features of the country under consideration is the great extent of navigable rivers. The Hudson Bay Company has always availed itself of this fact by using the water-ways, even when circuitous and difficult, rather than resort to land-carriage; and their inland posts, to as far north as the Arctic Circle, are now supplied from their central depot at Fort Garry, with only 114 miles of land-carriage, the greater part of which is from Edmonton to Athabasca Landing. From the latter place steamers and flat boats run to Fort Smith, on the Great Slave River, where twenty miles of wagon-road connect the shallow with deep water navigation; and a steamer distributes goods to the various posts down to the mouth of the Mackenzie, just above its estuary, where the river is said to be six miles wide, and up Peel River, which joins the Mackenzie near that point, to Fort Macpherson, on that gold-bearing stream. The great lakes which receive the drainage of this vast region, and give an equal flow to the Mackenzie, all have deep-water navigation, and, like most lakes of the Laurentian formation, are studded with islands. The western affluents of the Mackenzie are believed to form valuable links as a means of access to the mining districts of Peace and Liard Rivers. We have indicated by heavy lines those stretches of rivers which are considered navigable.

The great value of the fur trade in this vast region is so well known that it is not necessary to dwell on the remarks of the committee. Dr. R. Bell's map of the distribution of fur-bearing animals, which accompanies the report, will be found very instructive.

Extensive tracts of land have been traversed by miners, and the southern and eastern districts have in part been explored by members of the Geological Survey. From these and other sources an account of the economic sources of the Mackenzie region has been compiled, from which it appears that there are hardly any layers that would pay to be worked, the auriferous region adjoining the Rocky Mountains perhaps excepted. The extensive petroleum fields which are suspected to exist all along the Mackenzie may become of importance with the progressive settlement of Saskatchewan and Alberta. The committee is inclined to consider this oil-field of the greatest value, and recommends its thorough exploration.



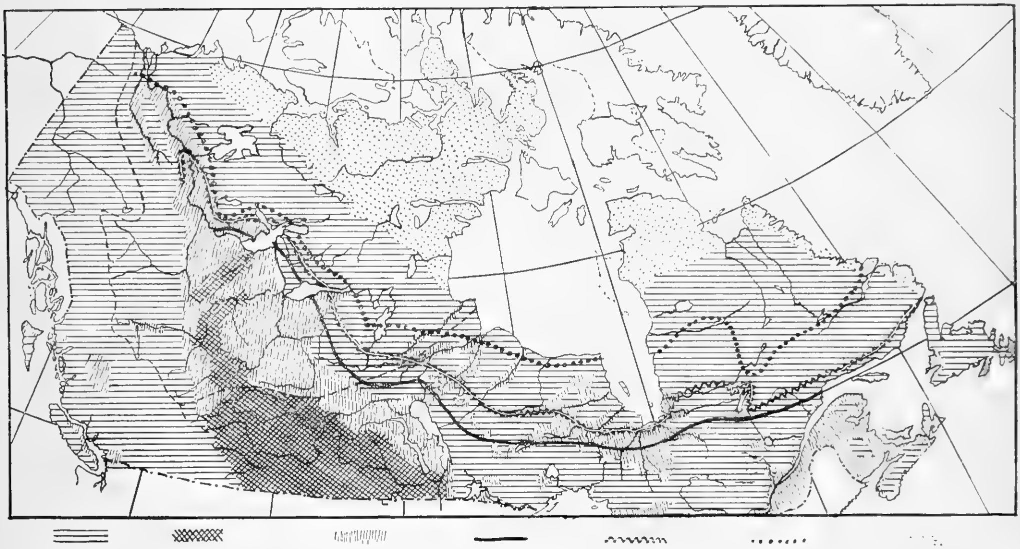
Lignite Territory. Petroleum Territory. Auriferous Territory.

The heavy lines show the navigable river-stretches and shore lines of lakes.

The principal question, however, is the extent to which agriculture can be carried on in the region under consideration. From a geographical point of view, the determination of the limits of the Barren Grounds is of great interest. For agricultural or pastoral purposes the greater portion of the wooded parts of the country is also waste land, the timber being of no commercial value, and the land being incapable of yielding any crops or of supporting sheep or cattle. Although many of the informants of the committee were inclined to describe the northern portions of the country too favorably, good judgment has been shown in not using such information in the construction of the map. It will be observed that the prairie region sends forth a narrow arm north-westward towards Peace River. The soil of this region is described as very fertile, but early frosts in August deprive it of much of its value. Notwithstanding this fact, it must be considered well adapted for stock-raising, and capable of supporting a considerable population. As the settle-

ment of the fertile prairie region on the Saskatchewan advances, these regions and their produce will become more valuable. It is worth remarking in this place, that the region near the southern limit of forests is far more valuable than the arid prairies near the forty-ninth parallel, adjoining Dakota and Montana, which are crossed by the Pacific Railroad. The political considerations which have determined the southern location of this road will undoubtedly prove to have retarded the growth of the Canadian North-West Territories. The information regarding the forest-covered area on the Mackenzie River, north of Great Slave Lake, is very scanty, and it appears doubtful whether the committee's views regarding its value as a pastoral area are justified.

On the whole, it appears that the south-western portions of the Mackenzie basin are far more productive than they were formerly believed to be, and that they are capable of supporting a considerable population. The country is far from being rich, and, while more promising areas are open to settlement, progress will be slow; but there can be no doubt that in course of time its prairies, woods, and mineral resources will give support to thrifty communities.



Wooded, mostly rocky and swampy. Arable and pasture lands. Prairie. Wooded. Northern limit of ripening of Wheat, Barley, Potatoes. Barren Grounds.

BOOK-REVIEWS.

Memory: What it is, and how to improve it. By DAVID KAY. New York, Appleton. 16°.

THIS volume, the eighth in the International Education Series, is in some respects the most important and interesting yet issued. We by no means underrate the value of Rosenkranz's 'Philosophy of Education,' nor that of Mr. Brown's translation of Preyer's 'Die Seele des Kindes;' for those works are broadening and stimulating, and should be read by all those teachers who are seeking to perfect themselves in the philosophy of their profession and to extend their knowledge of the phenomena of the child-mind. But Mr. Kay, in his treatment of memory, has had an opportunity to discuss, in the light of modern physiological and psychological research, a subject about which there has been a vast amount of almost wilful misunderstanding and ignorance. The commanding place which verbal memory occupies in the schools of to-day is a relic of the system of teaching current for the last five hundred years, and is the result of permitting educational practice to lag far behind psychological investigation. Mr. Kay's book makes such a discrepancy as that to which we refer, impossible any longer, for it brings within the reach of every teacher and student in the land a scientific and practical and modern treatment of the subject of memory and its cultivation. Professor Harris, the editor of the series, prefaces Mr. Kay's book with an interesting introduction, in which he sums up the result of the author's discussion. He says, for example, "Memory is not one faculty, so to speak, but a condition of activity of all faculties. There is one memory of places, another memory of the names of places; one memory of persons, another memory of the names of persons; still another memory of dates; another of principles and causes; and so on. The cultivation of one species of memory may assist or it may hinder another kind of memory, according as the mental activity by which the attention is fixed on one subject aids or hinders the mental activity of the other kind of memory" (p. vi.). We are disposed to think that Professor Harris does Mr. Kay an injustice in stating (p. xiii.) that Mr. Kay has not discussed the physiological side of memory with reference to the most recent special researches in physiological psychology. To be sure, we find no reference to Wundt, Volkmann, James Ward, Ebbinghaus, Fechner, or Meynert; but Ribot is quoted and referred to with great frequency, and we have also noticed quotations from Michael Foster, Dr. Carpenter, Dr. Maudsley, George Henry Lewes, Bernstein, E. Hering, Müller, Dr. L. S. Beale, Helmholtz, Du Bois-Reymond, and others, who are certainly in touch with the most modern theories in the branch of knowledge referred to. In fact, so far are we from agreeing with Professor Harris, that we are disposed to think that the first four chapters of Kay's book, which discuss 'Memory,' 'Matter and Mind,' 'The Body,' and 'The Senses,' form the most accurate and concise introduction to the study of physiological psychology that we have yet seen.

Every reader will be struck with the number of the author's citations. They are more than one thousand in number, and are taken from over two hundred authors. They in themselves would form an interesting *olla podrida* of what has been said and written about the subject with which the book deals. The author strikes at the current misconception of memory in the first pages of his book, and remarks (p. 13) that "a leading error that arises in regarding the memory as a single faculty is the belief, that, in whatever direction we exercise it, we improve it as a whole. This, however, is very far from being the case. If we exercise it only in one direction, we

improve it only in that direction. The exercise of the ear in hearing does not improve the power of vision, nor, while we strengthen the memory for sounds, do we improve that for sights. Even in a single sense or faculty, we find different forms and degrees of memory, as in sight for persons, places, forms, colors, and the like. Hence we may cultivate the memory for persons without at all improving that for places, and a good memory for colors may afford little help toward the remembrance of forms. . . . Another error that may be traced to the same cause is that of regarding the memory only or chiefly as it is manifested in its lower forms, and hence depreciating or undervaluing its importance. . . . The memory for names and words is the lowest form of memory, and fools and even idiots are sometimes found to manifest it in a very remarkable degree. Hence to judge of the value and importance of memory simply from the lower aspects of it is manifestly unfair. The memory for words is only one form of memory, besides which there are memories for ideas, for processes of reasoning, for creations of the imagination; and to say that memory interferes with efficiency of any of the other faculties is to regard as one thing what is in reality many things, and to confound the lower forms of it with the higher." The author distinguishes three kinds of forms of memory. The first, or lowest, is the local or verbal memory, which is the power of remembering facts in the order in which they occur, or words in the order in which they were addressed to the individual. This form of memory is very ready, and more or less imposing; it is nevertheless a manifestation merely of a mind which is very receptive to sense-impressions, and which consequently recalls them with great accuracy.

The second and higher form of memory is that in which not merely an individual past state of the mind, with its attending circumstances, is recalled, but where a number of past states having some resemblance to each other are reproduced at the same time. In the first kind of memory the associative principle at work was contiguity; in the second form it is similarity. The third and highest form of memory is that in which past ideas or past sensations are, as it were, imaged forth as if they were objects of actual perception. Wherever we find this power of imagination most highly developed, there we have memory in its most perfect form.

It will be seen that Mr. Kay is writing strictly on physiological lines when he makes this division of memory and his estimate of the importance of its various manifestations. He proceeds from the fact that there is a nervous discharge to correspond to every mental change, and that in the case of memory the discharge in question takes place in the same tract as it did when the presentation, now recalled, was originally perceived. He does not, however, confine himself to the opinion generally held by physiologists, that the movements on which our recalled sensations depend are confined to the brain, which may therefore be regarded as the sole seat of the memory. Mr. Kay says that this is the case in many instances; for instance, where the previous sensation is but imperfectly recalled. He contends, however, that where the previous sensation is brought back with any degree of vividness, as in the highest form of memory, the motion is not confined to the brain, but is conducted "also to the connecting nerves, and often to the special organ of sense, as in the original sensation, with this difference: that in sensation the motion originates in the external organ, and travels inward to the centre; whereas in recollection it originates in the centre, and passes outward to the outer organ" (p. 33). He supports himself in this opinion with a quotation from Professor Bain, and with some interesting experimental cases which we have not space to record. As a result of this opinion, the author can conclude that the senses are not only necessary for receiving impressions, but are necessary also for imaging them in the memory; and the muscles are not only necessary for the performance of actions, but necessary also for the full remembrance of them. Hence not the brain alone, but the whole body, is the true seat of memory.

We have given this rather full digest of Mr. Kay's views, because it is necessary, in reading and estimating the book, to know on precisely what foundation it builds. We cannot follow him over the remaining chapters of his book in as much detail, but we most cordially recommend his pages to the attention of all students of memory, and all who are engaged in the practical work of teaching. What he says about attention and association is, of course, well known to all save those who spend large sums of money in endeavoring to train the memory according to some secret and newly discovered "physiological" process. A careful study of Mr. Kay's book will dispel all illusions concerning such memory-training, and also make it plain that mnemonics as popularly understood is a self-evident absurdity; in that, instead of grasping a natural and real association, it calls up an artificial one, and makes it necessary for the mind to retain not merely the things associated, but the artificial bond of association which has been placed between them.

Mr. Kay's chapter on "How to Improve the Memory" is the shortest in the book, and reasonably so. If a clear impression of a sensation increases the likelihood of its being remembered, it is evident, that, in order to train the memory, we must begin by training the attention; if an idea can be the more readily recalled according as it is more easily associated with other ideas, then it is evident, that, after training the attention, we must train the power of associating ideas — not in an artificial and superficial way, but in accordance with the real connection existing between the ideas themselves; and, lastly, if there are memories, and not *a* memory, practice and exercise of any particular kind of memory is necessary in order to make it efficient. These are the practical rules resulting from Mr. Kay's treatment, and they are rules fully justified by physiology and psychology. The author has given us the best and most compact, the most accurate and the most practical, treatment of memory that we know of.

Case of Emperor Frederick III. Full Official Reports by the German Physicians and by Sir Morell Mackenzie. New York, Edgar S. Werner. 12°. $1.25.

THIS volume of 276 pages gives a complete account of one of the most celebrated cases of modern times, beginning with the month of January, 1887, when the Crown Prince of Germany felt the initial symptoms of his fatal illness, to June 15, 1888, the day on which as emperor he succumbed to its ravages. Twenty-two illustrations serve to make the reports of the physicians more intelligible than they otherwise would be. These represent the growth in the larynx at different stages of its progress, and the trachea after the operation of tracheotomy had been performed, with the canula through which air was admitted to the lungs. A perusal of this book leaves the disputed questions no nearer a solution than before, and we must be content to wait until sufficient time has elapsed to permit the subject to be considered from a purely scientific standpoint, without bias, either national or professional.

AMONG THE PUBLISHERS.

THE January number of *The Chautauquan* is replete with valuable and interesting matter. The following is the table of contents: 'Gossip about Greece,' by J. P. Mahaffy, M.A., of Dublin University; 'Nicias,' by Thomas D. Seymour, M.A., of Yale University; 'Greek Mythology,' by James Baldwin, Ph.D.; 'Sunday Readings,' selected by Bishop Vincent; 'Music among Animals,' by the Rev. J. G. Wood; 'The Effect of Explosives on Civilization,' by Charles E. Munroe, chemist of United States Torpedo Corps; 'Hospitals,' by Susan Hayes Ward; 'The Indians of the United States,' by J. B. Harrison; 'An Autocrat in Feathers,' by Olive Thorne Miller; 'Educate the Hand,' by Dr. T. L. Flood; 'The Chinese in the United States,' by Wong Chin Foo; 'Finland and the Finns,' by Bishop W. F. Mallalieu, LL.D.; 'Temperance Laws in the States and Territories,' by the Hon. H. W. Blair, United States Senator from New Hampshire; 'Working Girls' Societies,' by Grace H. Dodge; 'Alexander Hamilton,' by Coleman E. Bishop; 'Chapultepec,' by Eugene McQuillin; besides the usual editorial and C. L. S. C. departments. The poetry of the number is by Ada Iddings Gale and Hjalmer Hjorth Boyesen.

— The December number of *The Canada Educational Monthly* opens with an article on 'Some Antecedents of Montreal,' by Sir J. William Dawson, followed by the second part of the annual convocation address of President Sir Daniel Wilson of University College, Toronto. The first instalment of a brief history of Knox College, from the pen of Professor Gregg, next appears; then an article by Professor Fletcher, of Queen's, on 'University Matricula-

tion in Classics;' another on 'Botany in Country Schools;' and one on 'Professor Montgomery's Recent Explorations in Dakota of the Remains of Mound-Builders.'

— Charles Scribner's Sons have just ready a new volume by the Rev. Dr. Henry M. Field, in which the famous traveller describes 'Gibraltar,' giving an historical survey of the fortress and town. 'The Diary and Letters of Gouverneur Morris,' edited by Anne Cary Morris, also just issued, is crowded with material of international interest.

— Scores of books have been written about Spain and about northern Africa, but it has been left for Dr. Henry M. Field to write a most interesting volume about that unique bit of English territory that lies between these regions, 'Gibraltar' (New York, Scribner). The place is one that travellers are wont to give the go-by, and this fact imparts an unusual degree of novelty and freshness to Dr. Field's picture. The book gives, in a lively, entertaining narrative, just what we would wish to know about the fortress of Gibraltar, its appearance, history, construction, military and social life, etc. One climbs the rock with the author as a guide and commentator, goes through the fortifications, strolls around the town, is present at a parade, gets a glimpse of the society of the place, reviews the great siege more than a hundred years ago, with all of its details of heroism on the part of the besieged English and their French and Spanish assailants, and finally sails away from the picturesque spot to Africa. The numerous illustrations aid the reader materially in getting a capital idea of the famous fortress and town, and their surroundings.

From 'Gibraltar.' A VIEW OF GIBRALTAR. *Charles Scribner's Sons.*

— Macmillan & Co. will issue immediately 'Japan and its Art,' by Marcus B. Huish, founded on papers in the *Art Journal*, but revised and extended. The book, say the publishers, is the result of a year's constant intercourse with the most competent Japanese experts, and of study of the principal European collections. It will contain upwards of one hundred illustrations.

— Messrs. Ticknor & Co. published on Dec. 11, 'Imperial Germany,' a critical study of fact and character, by Sidney Whitman. This book deals with some characteristics of Germany as a nation, socially, politically, and intellectually, passing in survey over the historical development, and showing the elements by which German unity has been achieved, and especially noticing the play of the ideal element in the process. The growth of the Hohenzollern power and the characteristics in its more prominent personages which have gone to form the grit of the Prussian nation, and finally to make it supreme in Germany; the condition of the army and the leading influences that have combined to make it what it is, with glances at the traits of its great marshals; the social conditions both as they promise development and as they are still unripe for the complete freedom of expression of public opinion in the press or otherwise; the Philistine and his carping pettiness; society and the womankind; the family life and recreation and amusement, — all are glanced at and commented on, and anecdotes and instances supplied.

— D. Lothrop Co. have under way a book of travel by Henry E. Rhoades, of the Engineer Corps of the Navy, who was associated with Lieut.-Commander De Long, Lieutenant Chipp, and Chief Engineer Melville in the 'Polaris' Search Expedition in the Arctic in 1873, and who has been twice almost around the world. It will deal in an interesting way with the habits and customs of the people of the West Indies, of Brazil and other countries of South America, of Africa, Madagascar, the Comoro Islands, Arabia, India, China, Japan, Greenland, etc., and will be appropriately illustrated.

— It is a great compliment that the *Youth's Companion* has been appointed to be read in schools in various localities, Toledo among them.

— A. D. F. Randolph & Co. will publish at once 'The Fisherman's Daughter,' by Florence Montgomery.

— The Christmas number of *Harper's Weekly*, issued Dec. 12, consists of twenty-four pages. It contains an interesting sketch of Christmas customs in Germany by the Countess von Krockow.

— The sumptuous new volume of 'Mendelssohn's Letters,' lately published by Ticknor & Co., has received many most favorable notices. Mr. Gladstone says, "To Mendelssohn I feel grateful for his works, and I have also had the pleasure of hearing him play, some thirty or thirty-five years ago, in London. A few glances have shown me that the book will afford me a most agreeable perusal." Sir George Grove, author of the 'Dictionary of Music,' writes, "You have made me most happy with your beautiful book, and by the dedication, which is more than I deserve." Georg Henschel, the *maestro*, says, "I am almost through with it, and cannot tell you how I enjoyed it, and how splendidly the selections are made, and altogether how thoroughly you have succeeded in making the book highly interesting from beginning to end." Mendelssohn's eldest daughter says, "How charming the sketches are, and how very well done! I like every thing in and about the book, and personally enjoy it immensely. The letters read quite as if they had been written in English." And Robert Browning writes, "While I sat preparing the paper whereon to write, came the very book itself, — the dearest of books, just now. The best way will be to thank you at once, and be certain of finding plenty more to

thank you for when I have read what will interest me more than any thing else I can imagine in the way of biography."

— The English lady who writes under the pen name of 'E. Nesbit' has just made a collection of her later lyrics, which Longmans, Green, & Co. are about to publish. The book is called 'Leaves of Life.' The verse ranges from neatly turned and sharply pointed *vers de société* to serious poems of a high aspiration, frequently dramatic. Perhaps the most obvious characteristic of these poems is the sympathy the author reveals in them for modern moods of thought, and especially for the ambitions and revolts of the lowly.

— The late Lord Stanhope's 'Notes of Conversations with the Duke of Wellington,' just published in England by John Murray, will be issued in America by Longmans, Green, & Co. Lord Mahon was very intimate with the victor of Waterloo for the last twelve years of the Iron Duke's life, and he set down from day to day Wellington's table-talk, which is always interesting and often important. Wellington was as frank and as direct as Grant, and, like the great American commander, the Englishman was prompt to praise his chief adversary. Besides giving us Wellington's opinions of Napolean, of Talleyrand, of his own army, and of the comparison of himself to Marlborough, Lord Stanhope's book abounds in quotable anecdotes.

— An extra number of the Riverside Literature Series (published monthly by Houghton, Mifflin, & Co., Boston, at fifteen cents a number) has just been issued, entitled 'Scenes and Dialogues from the Writings of Harriet Beecher Stowe,' by Emily Weaver. The number contains selections from 'Uncle Tom's Cabin,' 'The Minister's Wooing,' and 'Old Town Folks.' The dialogues are well adapted for private theatricals, and are also especially suited to take the place of readings or recitations in school exercises. The same firm now have ready a new edition of Andrews and Stoddard's 'Latin Grammar,' revised by Professor Henry Preble of Harvard University.

— The *Publishers' Weekly* states that on the 29th of August next year the *Journal des Débats* will have been a hundred years in existence. Unlike other newspapers, its daily impressions are not numbered, so the reader looks in vain on the front sheet for evidence of its age. "Though founded in August, 1789, the *Débats*," so says the London *Athenæum*, "did not attain a leading place among French newspapers till some time after it had become the property of the brothers Bertin, who bought it in 1799." It has had an eventful career, and, as Lamartine wrote, its history during sixty years forms a part of the history of France. It is still regarded as a sort of stepping-stone or ante-chamber to the French academy on account of the large number of its eminent contributors who have become academicians. An historical account of the paper will be issued in celebration of its centenary.

— Houghton, Mifflin, & Co. will publish next February, F. Hopkinson Smith's new book of travel, 'A White Umbrella in Mexico,' with illustrations by the author. One of the chapters is given in the December *Century*, and another will appear in the January *Atlantic*.

— Mr. George Hannah, librarian of the Long Island Historical Society, addressed the Grolier Club, 64 Madison Ave., on the evening of Dec. 10, on 'Early Printed Books relating to America.' On Dec. 14 the Grolier Club opened an exhibition of the printed matter of which Mr. Hannah spoke, which will continue ten days. It was reported that work on the new club-house was progressing rapidly.

— The town of Dedham, Mass., has just issued a second volume of records, under the title of 'The Record of Baptisms, Marriages, and Deaths, and Admission to the Church, and Dismissals therefrom, transcribed from the Church Records in the Town of Dedham, Mass., 1638–1845; also all the Epitaphs in the Ancient Burial-Place in Dedham, together with the other Inscriptions before 1845 in the Three Parish Cemeteries,' edited by Don Gleason Hill, president of the Dedham Historical Society, and town clerk. Supplied by G. W. Humphrey, Dedham, Mass.

— George Forbes Kelly, 31 E. 17th Street, New York, has just issued the first series of 'The American Art Portfolio.' This is practically the cream of the first two volumes of *The Art Review*, now out of print.

— Gen. Benjamin Harrison, the President-elect of the United States, makes this pleasant allusion to Gen. W. T. Sherman, in a recent letter recommending the new Ticknor illustrated edition of 'Marching through Georgia:' "I was delighted to see how perfectly the artists have succeeded in illustrating the text of a song that no soldier, except it be the great captain who led the march, ever tires of hearing, and he, I think, only because his modesty is as great as his leadership was dashing and successful. The portrait of General Sherman is very spirited and lifelike."

— Gen. Regis de Trobriand, the gallant veteran of a hundred battles in defence of the Union, now lives in New Orleans, on the retired list of the United States Army. He is much pleased with Lieutenant Dauchy's translation of his 'Four Years in the Army of the Potomac' (just published by Ticknor & Co., Boston), and writes to the publishers, "My work enters a new career, all rejuvenated to bring back in vivid colors memories of great things accomplished by our generation, and not to be forgotten by those who come after us. The translation is excellent, and I can but be grateful to Mr. Dauchy, who undertook the labor and carried it through so successfully, and to you who took so good care to present it to the public in such an elegant form.

— The *Technology Architectural Review*, issued from the Architectural Department of the Massachusetts Institute of Technology eight times a year, promises to give American students of architecture "some of the broad training in design that must form part of the only foundation upon which any successful architectural career can be built."

— 'John Ward, Preacher,' the brilliant novel by Margaret Deland, is in its fifteenth thousand. The avidity with which the public seized upon this book was almost equal to that with which it has devoured 'Robert Elsmere.'

— William Q. Judge, New York, has just issued Mme. H. P. Blavatsky's new book, 'The Secret Doctrine,' the purpose of which is to "lay before the thinking world so much of the 'hidden wisdom'" — that is, of a divine degree of knowledge possible to human beings under certain conditions — "as it is thought expedient to make known at present to men in general."

— John Wiley & Sons have in preparation 'A Technical Dictionary, which will define, as an Authority, All the Terms of Art and Industry,' by Park Benjamin; 'The Guide to Piece Dyeing,' by F. W. Reisig, a practical dyer and chemist, and giving specimens of his own color-work and 100 recipes for the same; 'Steam-Engine Design for the Use of Mechanical Engineers, Students, and Draughtsmen,' by Prof. J. M. Witham, late assistant engineer U. S. Navy; and a 'Treatise on Linear Differential Equations,' by Prof. T. Craig of the Johns Hopkins University.

— The 'Johns Hopkins University Studies for 1889' will be devoted to (1) 'Arnold Toynbee,' by F. C. Montague, fellow of Oriel College, with an account of the work of Toynbee Hall in East London by Philip Lyttelton Gell, chairman of the council; also an account of the Neighborhood Guild in New York, by Charles B. Stover, A.B.; (2–3) 'The Establishment of Municipal Government in San Francisco,' by Bernard Moses, professor of history and politics in the University of California; (4) 'The City Government of New Orleans,' by Judge William W. Howe; (5) 'The City Government of Chicago, with a Bibliography on Municipal Government in the United States,' by F. H. Hodder, instructor in history in Cornell University; (6) 'A New England Village Community, a Study of Wethersfield, Windsor, and Hartford,' by Charles M. Andrews; (7) 'The Study of History in France and Germany,' by Prof. Paul Fredericq of the University of Ghent, translated by Henrietta Leonard; (8) 'Federal Government in Canada,' by James G. Bourinot, clerk of the Canadian House of Commons; (9) 'Local Government in Wisconsin,' by David E. Spencer; (10–11) 'The Gilmer Letters, an Account of the English Professors obtained by Gilmer and Jefferson for the University of Virginia,' by William P. Trent, professor of history and English in the University of the South; (12) 'Higher Education of the People, a Series of Social

and Educational Studies,' by Herbert B. Adams of Johns Hopkins University.

— Charles W. Sever, Cambridge, Mass., announces a new and enlarged edition of 'Songs of Harvard.' It contains all the latest and most popular songs and glees sung by the Harvard Glee Club and students of other American colleges. The book has already run through three large editions, and has met with great favor wherever introduced. Of Stories from the Persian, 'Abdulla of Khorassan' and 'Ahmed the Cobbler,' published by the same house, and edited by Prof. F. J. Child, the Boston *Advertiser* says, "These tales are taken from Malcolm's 'Sketches of Persia,' one of the most agreeable books in the English language, though it seems scarcely to be known to the present generation of Americans. If the two tales herein preserved are a sample of the entire book, it fully deserves the high praise that Professor Child has given it.

— In the *Magazine of Art* for January (New York, Cassell & Co.) the frontispiece is a photogravure from a painting by R. Caton Woodville, called 'Saving the Guns at Mainward.' The opening article, by Cosmo Monkhouse, gives a sketch of the young English sculptor, Alfred Gilbert, and a portrait. 'Art in the Theatre' is the subject of the next paper, giving some illustrations from the work of some famous scene-painters. 'Salisbury Hall' is a description with pen and pencil of one of those picturesque old places found nowhere in such perfection as in England. The second paper on the 'Liverpool Corporation Collection' shows that shipping-centre to be a liberal patron of the fine arts. William G. Rossetti has another paper on the portraits of his brother Dante Gabriel. 'Expressions in Drapery' is a carefully prepared paper by Annie Williams, for which studies by Sir Frederick Leighton serve as illustrations. A full-page engraving of Mr. Homo Thornycroft's statue of General Gordon, erected in Trafalgar Square, brings us to the notes, which are full.

— The romantic and picturesque side of 'Castle Life in the Middle Ages' will be described by E. H. and E. W. Blashfield in the January *Scribner's*, with many illustrations from drawings by E. H. Blashfield; Gen. E. P. Alexander, president of the Georgia Central Railroad, and one of the most widely known railroad men in the South, will write of 'Railway Management;' Thomas Bailey Aldrich, editor of *The Atlantic*, will write of some bright memories of his birthplace, Portsmouth, N.H. (his paper, entitled 'Odd Sticks,' is the first of the series of final papers which replaces the feature contributed last year by Robert Louis Stevenson); Miss Sarah Orne Jewett, whose work has heretofore dwelt with New England character, will contribute a story in an entirely different field, describing the family life of a respectable Irish-American saloon-keeper; and Robert Louis Stevenson, who spent last winter in the Adirondacks, describes a series of remarkable adventures in that region. The time is in the last century, when the wilderness was almost pathless.

— The United States Geological Survey has just published Bulletin 47, an analysis of the waters of the Yellowstone Park, by Messrs. Gooch and Whitfield of Prof. F. W. Clarke's staff. The analyses seem to have been verv thorough, and sufficiently numerous to make accurate generalization possible. Physicians will be interested in the fact that arsenic and lithia were present in appreciable quantities, while iodine was conspicuously absent, and bromine was rarely found.

— John Wiley & Sons have just issued a new and improved edition of 'The Principles of Thermodynamics, with Special Applications to Hot-Air, Gas, and Steam Engines,' by Robert Röntgen, teacher in the Polytechnic School at Remscheid; translated, revised, and enlarged by A. Jay Du Bois, Ph.D., professor of dynamic engineering in the Sheffield Scientific School of Yale College. Very considerable additions have been made to the present edition. The application of the calculus to the subject has been given with sufficient fulness, in the shape of additions to Chapters VII. and XVIII. All examples and formulæ are given throughout the work in both French and English units, and the steam tables of Zeuner are given complete, both in their original French units, and also reduced throughout to English units. Many new examples have been added.

— Prof. David P. Todd of Amherst College, Amherst, Mass., has published a very useful pamphlet, 'Instructions for observing the Total Eclipse of the Sun, Jan. 1, 1889.' In a recent issue of *Science* we traced the course of this eclipse through California. It will be visible from northern California to Manitoba, the duration of totality decreasing from $1^m 57^s$ to $0^m 12^s$. Valuable observations may be made by amateurs without the aid of elaborate instruments, and it is particularly for the use of this class of observers that these instructions have been compiled. Professor Todd desires them to make sketches of the entire corona, and of the corona near the north and south poles of the sun's disk; sketches of the outer corona; and observations of the duration of the total eclipse. The latter observation is particularly desirable at places near the limits of totality. Instructions to amateur photographers conclude the useful pamphlet. The author requests that drawings or observations of this kind be forwarded to him.

— The third number of the *Journal of American Folk-Lore*, which has just been issued, concludes the first volume. While the journal was originally not intended to appear at regular intervals, the large amount of available material, and the general interest in its contents, have made it necessary to issue it as a quarterly. The present number contains a valuable paper by Prof. Horatio Hale on 'Huron Folk-Lore,' which will be continued in the next number; descriptions of Onondaga customs, by De Cost Smith and W. M. Beauchamp, and several other papers on Indian lore. Mr. W. W. Newell publishes a collection of a number of English folk-tales as told in America. For the coming volume a number of interesting contributions are announced on Indian lore as well as on that of Europeans settled in America. Attention will be paid to a full record of publications on American folk-lore.

— With the recent publication of the sixth part of his 'Butterflies of North America,' Mr. Edwards has issued eighteen plates of that incomparable iconography within two years, which is almost exactly fulfilling the promise of the first part. Considering the special difficulties which have stood in his way, this result is very gratifying. The present part is a most interesting one, giving such full illustrations of every stage of *Anthocharis genutia* and *Neonympha areolatus* as to leave hardly any thing to be desired. The artists have taken such evident pains in the execution of every detail, that the truthfulness of the illustrations is almost self-evident. We miss in part the exquisite work that Mrs. Peart has done, for she was unquestionably without a rival among American artists in this class of delineation on stone; but her standard has induced such excellence in her followers, that, but for what had preceded, we should be inclined to call this perfection. Credit must be given Mr. Edwards for this, for such excellence comes only from demand and from persistent purpose. Western species of *Anthocharis* and *Papilio*, with the chrysalis of the former, complete the series. Thanks mainly to Edwards, the complete histories of nearly all the various types of Satyrids in our country are now very well known, — better known, indeed, than are those of Europe, where, from the greater diversity of forms in this group, the opportunities are very much greater.

— Prof. Robert T. Hill, in a recent bulletin of the United States Geological Survey, gives a very useful summary of the history of geological investigation in Texas up to the year 1886. The first part of his work treats of the history of surveys, describing those of European travellers — among whom F. Roemer's work is of special importance — first. Next the United States military reconnaissances and explorations are recorded, and a history of the attempts to establish a State geological survey is given. The second part treats in a concise manner of the results of these investigations, the foundations on which the present work is to be carried on. Professor Hill has worked hard to arouse interest in geological work in Texas, and it is a matter of congratulation that his endeavors have been successful. His own contributions warrant that the work undertaken under his direction will yield important results.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

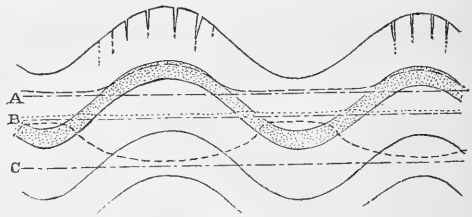
Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Synclinal Mountains and Anticlinal Valleys.

IN the recent reading of two very different books a statement is encountered that seems incomplete, and to a certain extent misleading, regarding the origin of synclinal mountains and their accompanying anticlinal valleys. The first book is an advanced monograph, entitled 'Les Formes du Terrain,' by La Noë and Margerie, in which it is stated (p. 150) that "finally a very remarkable consequence of erosion in regions of folded structure is to give rise to an ultimate arrangement of relief in which the original depressions are replaced by elevations, and *vice versa*." This generalization seems too broad. In the first place, the only ultimate form of land-sculpture is the base-level plain, down to which every surface must be reduced, whatever its structure, if time be allowed. Of this the authors are undoubtedly aware, and their term 'finale' should perhaps be rendered 'late' rather than 'ultimate.' But, in the second place, it is by no means essential that late forms developed by erosion on folded structures should present the inversion referred to. It is not a necessary or even a general result of progressive denudation, but simply a special result of a certain relative position of hard beds and the controlling base-level. For example: let the dotted stratum in the accompanying figure be a hard sandstone, while the other beds are soft shales and limestones. If the base-level be at *A*, a little below the arches of the hard bed but above its troughs, a late form assumed in the progress of denuation will be broad synclinal lowlands between anticlinal ridges (shown in long-broken lines, —— —— ——). In this case the late form corresponds to the original structural surface. But if the base-level is at *C*, the opportunity for quick erosion that is afforded on the lower soft beds, when they are discovered by the breaching of the anticlinal crests, will soon cause the chief water-courses to abandon the synclinal axes that they had before followed, and excavate their valleys along the anticlinal axes. In this case the late form (shown by short-broken lines, — — — —) consists of synclinal ridges or mountains, and there has been an inversion from the original structural surface. It may be added that this result is favored if the region is first base-levelled at an altitude like *B* (the ultimate form in this cycle of development being shown in the dotted line . . . .), and then bodily elevated so that the base-level falls to *C*; and this, I think (following suggestions from Gilbert and McGee), has been the case with the Appalachians.

The second book referred to is Hinman's 'Eclectic Physical Geography,' recently published. The Jura Mountains are taken as examples of young forms, in which the anticlinals are ridges: the Appalachians are chosen as examples of old forms, in which many anticlinals are worn down to valleys. By the time the Jura "have suffered erosion as long as the Appalachians, the present position of the mountains and valleys will have been reversed" (p. 261). It



seems pretty certain that when the Jura have suffered erosion as long as the Appalachians, they will be worn down flat; and whether an inversion of ridges and valleys will take place, or not, during this erosion, is entirely a special result of the relative attitude of hard beds and base-level, as above illustrated, and by no means open to unqualified prediction on general principles.

From finding the above statements concerning the origin of synclinal mountains in two books whose objects are so dissimilar, I have inferred that they represent a general belief, in which a special case is conceived to be a general one: hence this brief note on the subject. The question is a small one, and unnecessary in general accounts of geographic forms; but when the progress of denudation is alluded to, and early and late forms are distinguished, it is essential that the principles of classification should be clearly stated, it one would gain a full understanding of the systematic development of the surface of the earth.

W. M. DAVIS.

Philadelphia, Penn., Dec. 12.

Publications received at Editor's Office, Dec. 3-15.

ADVOCATE, The. Vol. I. No. 1. St. Paul, Minn., Ramaley & Sons. 32 p. 4°. $2 per year.
AUSTEN, P. T. Chemical Lecture Notes. New York, Wiley. 98 p. 12°. $1.
BASTIAN, A. Allerlei aus Volks-und Menschenkunde. Vols I. and II. Berlin, E. S. Mittler & Son. 892 p., pl. 8°.
—— Die Culturländer des alten America. Vol. III. Part II. Berlin, Wiedmann. 66 p. 8°.
BOEHMER, G. H. Systematic arrangement of the List of Foreign Correspondents, July, 1888. Washington, Government. 201 p. 8°.
—— Additions and Corrections to the List of Foreign Correspondents, to July 1888. Washington, Government. 147 p. 8°.
DAY, D. T. Mineral Resources of the United States, 1887. Washington, Government. 832 p. 8°.
FREDERICK III., Emperor, Case of. Full Official Reports by the German Physicians and by Sir Morell Mackenzie. German tr. by Henry Schweig, M.D. New York, E. S. Werner. 276 p. 12°.
HALF Hours in Science and Art. Vol. I. No. 1. Fostoria, O, Half Hour Publishing House. 8 p. f°. 50 cents per year.
HOLDEN, E. S. Suggestions for observing the Total Eclipse of the Sun on January 1, 1889. Sacramento, Cal., State. 21 p. 8°.
MUSEUM für Völkerkunde, Veröffentlichungen aus dem Königlichen. Vol. I. No. 1, October. Berlin, Spemann. 16 p. f°.
NEUMAYER, G. Anleitung zu wissenschaftlichen Beobachtungen auf Reisen. 2d ed. Berlin, Robert Oppenheim. 24 p. 12°.
NIPHER, F. E. Missouri Rainfall. St. Louis, The Author. 7 p. 12°.
SAUNDERS, W. Insects injurious to Fruits. 2d ed. Philadelphia, Lippincott. 436 p. 12°. $2.
U. S. ARMY. Annual Report of the Chief of Engineers, 1888. Washington, Government. 341 p. 8°.
U. S. NATIONAL MUSEUM, Proceedings of the, 1887. Vol. X. Washington, Government. 771 p. 8°.

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SCIENCE

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SCIENCE

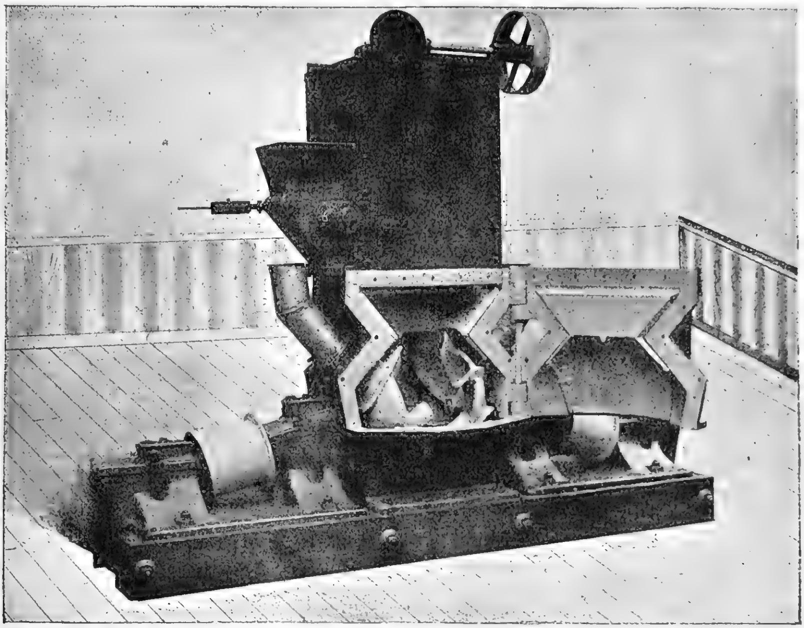
FRIDAY, DECEMBER 28, 1888.

THE McAULEY PROCESS OF BURNING PULVERIZED FUEL.

ONE of the most important problems of the day is that of the economical use of fuel, and much ingenuity has been expended in attempts to find its best solution. We are all interested in this matter, for we are all in some way connected with the fuel question. Iron and steel furnaces, factories, locomotives, steamships, and the domestic hearth, — one and all are most lavish users of fuel. When it is considered that it is theoretically possible to generate one horse-power by the consumption of a quarter of a pound of coal per hour, and this is compared with the results of actual practice, an idea is obtained of the room for improvement. An ordinary non-expansive, non-condensing engine requires commonly from ten to twelve pounds of coal per hour, while in our best expansive and condensing engines the same amount of work is accomplished with only two pounds per hour. But the latter figure represents excellent practice rarely reached by the majority of even large fuel-consumers. The average consumption of coal may be taken as at least four pounds per horse-power hour.

At the present day nearly all efforts to further economize fuel are being exerted in the direction of better boilers and furnaces, more efficient engines, a higher grade of workmanship, and more skilful management; in fact, in the more economical use of the heat after it has been obtained. Many inventors have, nevertheless, with varying degrees of success, attempted the solution of the fuel problem by attacking it from the other end; i.e., by endeavoring to secure the more perfect combustion of the fuel itself, as well as the burning of cheaper fuel than ordinary coal. All manner of patent fuels have been tried, and some with a fair degree of success. Mechanical firing has also been resorted to, but in all such processes there seem to have been objectionable features of great magnitude.

It has long been recognized that if coal could be very finely pulverized, and each little particle of coal could be surrounded with a film of air on its way to the furnace, the combustion ensuing would be very much improved. Many have been the devices to burn pulverized fuel in such a manner; but the success achieved has usually been small, and the difficulties besetting the problem have appeared insurmountable. A very promising effort in this direction is that of Mr. J. G. McAuley of Lansing, Mich. Vague mentions of his method have from time to time reached the public, but it is only within a short time that his process seems to have been brought to practical perfection. In order to satisfy certain capitalists of its merits, the process was applied, some time ago, to one of the puddling-furnaces of the Chester Rolling Mills of Chester, Penn., and the writer enjoyed the advantage of being present for several days during this test. The idea underlying this process is that of the automatic delivery into the combustion-chamber of a regular supply of finely pulverized coal, each little particle of the latter being surrounded by a film of air while on its way to the combustion-chamber; so that, on arriving there, combustion may be nearly instantaneous and practically perfect.



THE CYCLONE PULVERIZER.

The manner of obtaining this highly desirable result is ingenious and extremely simple. The combustion-chamber of the furnace is

tightly closed, having neither grate-bars nor ash-pit. Into the front of this chamber, and on the same level, there enter two short horizontal pipes, or *tuyeres*, about two feet apart. The outer ends of these *tuyeres* are connected to a main air blast-pipe, which is kept filled with air under a slight pressure by means of an ordinary blower. Simple valves permit the ready and accurate adjustment of the amount of air passing through the *tuyeres* into the combustion-chamber. Between and slightly above these *tuyeres* is a small rectangular hopper, into the top of which the finely pulverized coal is fed by screw-conveyers. The coal is fed out of the hopper by means of an ordinary screw of about two inches diameter, which passes horizontally through the lower portion of the hopper, issuing from its opposite sides through holes just large enough to loosely fit the outside of the screw. The pulverized coal lodges between the threads of the screw, and, on revolving the latter, the coal is fed out through the side of the hopper. One end of the screw is right-handed, and the other is left-handed, though both ends are of the same pitch. It follows, therefore, that the coal will be fed out of both ends of the hopper at exactly the same rate, this rate depending on the speed of revolution of the screw. The coal is kept from packing or becoming solidly wedged in the hopper by means of an agitator kept in motion immediately above the feeding-screw. On issuing from the hopper, the pulverized coal drops into the *tuyeres* directly below, and is carried to the combustion-chamber by the blast of air passing through the *tuyeres*, becoming intimately mixed with this air at the same time. Only enough air is admitted to secure complete combustion, thus avoiding the great loss due to the excessive amount of air necessarily admitted when burning lump-coal on an ordinary grate. The feeding-screw is operated by gearing driven from a convenient line of shafting, such arrangements being made as will secure a readily and accurately adjustable motion of the screw, and hence a readily and accurately adjustable feed of the fuel.

As the relative as well as absolute amounts of coal and of air can thus be adjusted at will, and with any desired degree of precision, it follows that the character and intensity of the flame are completely under control. The ability to thus produce, and maintain for any desired length of time, a flame of any desired intensity, and either reducing, neutral, or oxidizing in character, carries with it, for metallurgical purposes, many advantages too well known to need more than a passing allusion.

In the Chester Rolling Mills the apparatus was attached directly to the combustion-chamber of one of their regular puddling-furnaces, though greater economy would probably have been obtained by the use of a special form of combustion-chamber devised for this purpose. The coal was the same as that used for all the other puddling-furnaces, except that it was pulverized. No conveyers were fitted to feed coal into the hopper, the coal being furnished in bags of one hundred pounds each, which were emptied into the hopper as required. As thus applied, this process realized a very large measure of success. The furnace was heated more rapidly after charging than the other furnaces, which were being worked in the ordinary manner, though with the same iron. More heats were obtained per day with the new process, less fuel was consumed per ton of iron produced, less iron was wasted in puddling, and the iron produced proved to be of slightly superior quality. There was no smoke, and the ashes was carried out of the top of the chimney in the form of fine dust, invisible from the ground. While charging the furnace, the supply of both air and fuel was completely stopped, thus preventing waste, and enabling the men to work more quickly. In considering the superior economy of this process, it must be borne in mind that the actual economy in the production of heat from any given fuel does not represent the total gain; for by this process very cheap and otherwise comparatively useless slack coal and coal-dust will answer nearly all purposes, thus presenting another material advantage.

It is of course impossible to give exact figures, except from observations extending over a much longer period of time than was at my disposal at Chester. There can, however, be no question that the McAuley process effects a considerable and substantial gain in economy of fuel-consumption. There remains simply the determination of the exact amount of this gain by means of accurately conducted experiments by scientific and practical experts.

The process has very recently been applied to the puddling-furnaces of the Warren Iron and Steel Company at Warren, O., and the success obtained seems to have been very great. A report of the trial there given this process has just reached me, and reads as follows: —

"The results of the trial just completed at the works of the Warren Iron and Steel Company, Warren, O., with the McAuley pulverized fuel system, are remarkable. The trials covered forty-six on two of the puddling-furnaces. The furnaces were charged with 23,000 pounds of iron during the trial. The amount of pulverized coal used was 12,260 pounds (a little over six tons). The cost of this fuel was $5.43. The amount of iron drawn from the furnaces was 24,029 pounds, an excess of 1,029 pounds over the amount put in the furnaces originally. This is what the McAuley system accomplished.

"By the old process, now in use, during the same heats, the amount of coal required was 36,920 pounds (over eighteen tons), the cost of which was $16.50: in other words, the McAuley process saved nearly 75 per cent of fuel. The McAuley process increased the amount of iron 5½ per cent; that is, there was 5½ per cent more iron taken out by the new process than was charged. This gain is worth $15.45: in other words, the gain in iron alone pays for nearly three times as much coal as is required by the McAuley process. The iron-men who witnessed the trials were astonished at the remarkable results. The iron gained by the McAuley process comes from the 'fix' which is used to protect the pan and sides from the intense heat, and also from the cinder, containing 50 per cent of iron, which is put in the furnaces to flux the iron. By the old process this is all lost, and in addition there is generally over 5 per cent of waste. This means practically an actual gain of 10 per cent of iron by the new system."

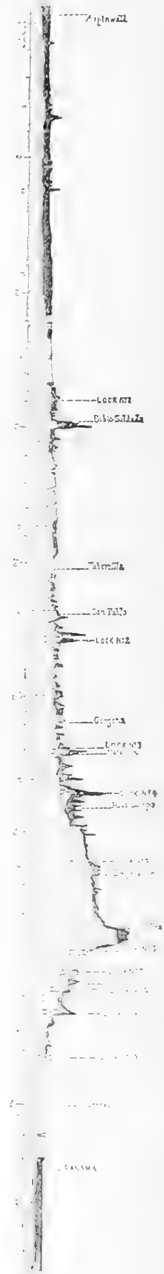
The puddling process makes specially severe demands on any such automatic fuel-feeder; and hence even better results may be expected from the application of the new process to steam-boilers, both land and marine. It should prove especially valuable in marine boilers; for not only would the required speed be developed at less expense, but less coal would have to be carried for any given trip, and the space and weight so gained would, of course, be available for carrying paying freight.

Without going into any further details, it may be broadly stated that there are very few cases in which fuel is consumed in large quantities, where it could not be burned more advantageously in the pulverized form; and, as there can be no question that the McAuley economizer is the best apparatus yet invented for this purpose, it seems as though it were destined to work a great revolution in the manner and economy of consumption of fuel.

In conclusion, it may be of interest to state that the coal is pulverized for this process by means of the Cyclone pulverizer, the principle of which is fairly indicated by its name. Within a closed chamber a pair of wheels resembling three-bladed screw-propellers revolve very near each other at a great velocity, but in opposite directions. Two powerful currents of air in opposite directions are thus generated, their joint effect being to produce a miniature whirlwind within the chamber. Into the vortex of this enclosed cyclone the coal is regularly dropped, and is rapidly ground into the finest powder by the mutual attrition of its particles. There is no grinding or pulverizing by the direct action of any of the metal parts of the machine, so that the machine does a great deal of work with extremely little wear. X.

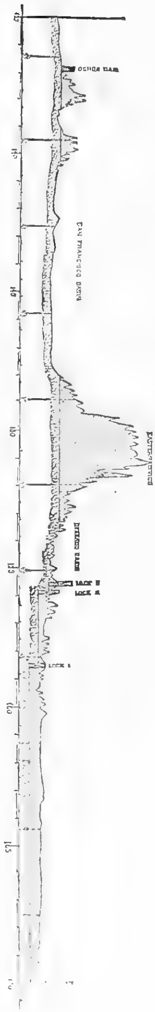
PROFILES OF THE NICARAGUA AND PANAMA CANALS.

THE failure of the Panama Canal Company makes the uninterrupted continuance of work on the canal very doubtful, and thus the chances of the Nicaragua Canal being the first to be completed have materially increased. The profiles on p. 323 show a comparative statement of the amount of excavating to be done in both canals; and it will be seen at a single glance, that, even considering the amount of work already accomplished at Panama, the Nicaragua route is by far the less difficult. The profiles do not show the works necessary for protecting the canal, such as dams

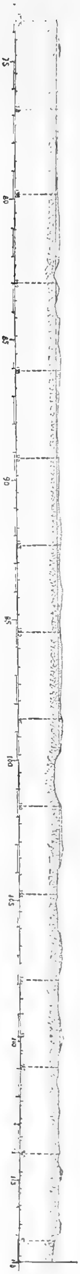


PROFILE OF THE PANAMA CANAL.

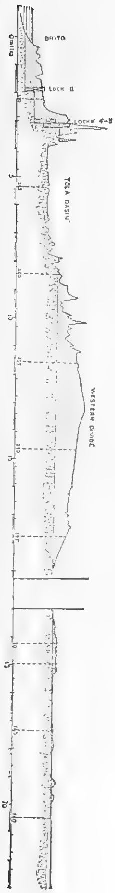
Black indicates work executed; stipple, work to be executed to complete a lock-canal; white, additional work to be executed to complete a sea-level canal.



Eastern Portion: from Greytown to the Dam of Ochoa.



Central Portion: from the Dam of Ochoa to Lake Nicaragua; Bed of San Juan River.



Western Portion: from Lake Nicaragua to Brito.

PROFILE OF THE NICARAGUA CANAL (LOCATION OF 1888).

Stipple indicates amount of work to be executed to complete the canal.

and digging new canals for deviating rivers, etc., but these works are far more formidable in Panama than on the Isthmus of Nicaragua. The control of the Chagres River has been one of the most serious obstacles to successfully carrying on the work at Panama. On the route selected for the Nicaragua Canal by the surveying party of 1885, obstacles of a similar kind would have been encountered in the basin of the Rio Grande between Lake Nicaragua and Brito; but in the new plan of 1888 this difficulty has been overcome by damming up the river, and transforming its valley into an artificial lake, the Tola basin.

On the profile of the Panama Canal may be seen both the volumes to be excavated for the purpose of establishing a lock-canal and a sea-level canal. The number of locks necessary for the former is ten, while the plan of the Nicaragua Canal contemplates only six locks. A single glance shows that by far the greater amount of work necessary to complete a sea-level canal remains to be done, and that comparatively little has been accomplished in the most difficult sections of the canal. While it seems impossible to complete the deep Culebra cut on account of the movements of the soil, no such difficulties are anticipated in the short deep cut of the Nicaragua Canal crossing the eastern divide. Careful borings have shown the soundness of the rock.

If we consider that the Nicaragua Canal Company is just starting its work, while the Panama Canal Company is burdened with an enormous debt; that the amount of work left to be done is smaller in Nicaragua than in Panama, — we must regard the prospects of the former as very encouraging.

The profile of the Panama Canal shows, on the other hand, the amount of work done as compared to that left unfinished. Much money has been expended; and the interests at stake are so powerful, that we do not believe the work will be dropped, but will be pursued in some way or other. A decrease of the working force seems to be, however, at present unavoidable, and this will relieve the Nicaragua Canal Company of another difficulty, the scarcity of workingmen in these tropical regions. If the work on the latter is undertaken without unnecessary delay, and if it is continued as carefully as the preliminary surveys warrant it will be, we expect to see it completed at an early day. The Panama Canal, even if opened at a later day, will have to contend against an established route, run at smaller expense than its own, as the capital invested and the number of locks, which cause increased expense, will be smaller.

THE SPRAGUE ELECTRIC ROAD AT BOSTON.

WE take pleasure in presenting our readers in this issue of our paper with a general view of the new electric street-railway between Boston and Brookline, installed by the Sprague Electric Railway and Motor Company of New York. There have been several trial trips made over this railway already, to test the apparatus, which has been found to be perfect, and the road will be put into commercial operation in a few days.

The West End Street Railway of Boston, of which this road is a part, is the largest street-railway in the world. It extends over 212 miles of track, using 1,700 cars and more than 9,000 horses. The president of the West End Street Railway Company, Mr. Henry M. Whitney of Boston, is universally recognized as being one of the most enterprising and successful street-railway men in the country, and, aided by an efficient corps of assistants, has succeeded in giving Boston since his administration the most efficient street-railway service which ever existed in that city.

Before deciding upon any electric system to be adopted upon the West End Road, President Whitney, accompanied by members of the board of directors and managers, visited all the principal electric railways in the country operated upon the various systems, including visits upon three different occasions to Richmond, Va., to inspect the famous electric road in operation there upon the Sprague system. After a most careful examination of all these different roads, the contract for equipping the West End Road was awarded by the board of directors to the Sprague Electric Railway and Motor Company of New York.

This system of electric railway called for in this contract is wide and comprehensive. The main line from Boston westward, beginning at Park Square, will run down Boylston Street bridge, and then down Chester Park to Beacon Street. It will then proceed over the Beacon Street extension to the Chestnut Hill Reservoir, and to Allston, and Oak Square, Brighton. From the East Park gate, over the new boulevard to the Chestnut Hill Reservoir and Brighton, the Sprague overhead system will be adopted; in the more crowded streets of the city the Bentley-Knight conduit will be used; and the Sprague cars will run over the whole system.

The power-station from which the electric current is distributed to the line is situated on Braintree Street, Allston, near the Boston and Albany Railroad, and also at the edge of the water, thus giving both water and rail facilities for fuel. This building, which is the most perfect electric plant of its kind in the country, is situated very nearly equidistant from the extremities, and is therefore literally a central station. The station, with the adjoining car-house, is of brick, and completely fire-proof.

In its construction it was the aim of the West End Company to get the best in every detail. The chimney-stack is 100 feet high. The boiler-house, which is both convenient and commodious, is at present equipped with three horizontal tubular boilers, furnished by the Jarvis Engineering Company. The engine-room contains two high-speed automatic cut-off engines of the Armington & Sims pattern, of 200 horse-power each. Each drives two powerful dynamos of 80,000 watts each, and wound for a maximum pressure of 500 volts. These dynamos are of the highest efficiency and simplest construction, and, if need be, can be placed under the charge of the steam-engineer. The dynamos feed into copper bus wires, supported on the walls by porcelain insulators.

Each machine has its independent ampère meter, and in addition there is a general ampère meter at the end of the positive bus bar. From this bar the current passes to special snap-switches, each switch being connected through a three-plug safety-switch back to one of the feeders supplying current to the main line-wire. These feeder-wires tap into the line-wire at different points on the line of road, thus maintaining the pressure approximately equal all along the line. At the ends of the feeders in the central station, pressure-indicators are attached, which indicate the voltage at the junctions of the feeders with the main current-wire.

The engine-room is brilliantly lighted by handsome hanging electroliers, each of which has five incandescent lamps. A switch-board at one end of the room furnishes an independent control for each group of lamps. All the surroundings of the machines are kept in the neatest condition.

Adjoining the power-house, but separated by thick brick walls, is a commodious house for accommodation of cars, 107 feet long by 80 feet deep, designed to hold 24 cars.

The overhead system, which is built under the Sprague patents, is of the finest description, and includes iron poles set in concrete throughout the entire length of the road. These poles are of a very neat and tasteful pattern, and support the span-wires which carry the trolley-wire at a height of 18 feet over the centre of the track. This overhead wire, which is used for a working conductor, is made of silicon bronze, of the small Sprague type, only three-sixteenths of an inch in diameter. This is the only wire suspended over the middle of the track, and its lightness and high tensile strength allow the overhead supporting structure to be of the lightest description possible. The poles are 125 feet apart.

The return circuit is through the rail, and thence by both metallic and ground circuits to the station. Each section of rail is joined to copper ground wires throughout the length of the road underneath the string-pieces. At intervals of 500 feet this ground wire is connected to an earth plate, and at seven points widely distributed. The ground wire is connected to the station, and there is also a main ground connection made there through a large sink-plate.

In the overhead system a new method of switching has been adopted, which is at once ingenious and simple. Five or six feet inside the turnouts a small switch with flaring rider is interpolated into the main and branch wires, and a spring tongue upon this directs the path of the trolley with absolute certainty and ease. By this means, switching is made very easy, and all danger of the trolley leaving the wire is obviated.

The cars can be run at widely different speeds, varying from the slowest crawl to twelve or more miles per hour. They can be

started and stopped without the use of brakes in the space of three or four inches, and, when making the normal running speed, can, in an emergency, be stopped and reversed without brakes within less than a quarter of a car length. This is especially advantageous in crowded thoroughfares, and shows the superiority of the electrical car over the horse or cable cars. The control over the car seems marvellous, for one sees little or nothing save an almost imperceptible movement of the hand of the motor-man ; and the starting, although prompt, is very gradual and without shock or jar. The ordinary driver can operate one of these cars without the slightest trouble, after a very brief instruction. The saving on the operating cost of the Sprague system, owing to the superior quality of the apparatus, over an ordinary horse-car line, constitutes a no inconsiderable item. It has been found that the average cost of motive power per car a day throughout the United States — that is, for from ten to eleven hours, and trips aggregating from forty-five to fifty miles — is about four dollars, and this counts only those horses on actual duty on the road. The cost of motive power per day per car for equal mileage in Richmond is less than two dollars on the heaviest sort of grade-work, and at Boston it is estimated that even this low cost of operation will be reduced. For winter use upon this road the Sprague Company is equipping three electric 'working-cars,' furnished with snow-ploughs, brushes, ice-cutter, and salt-distributer, and each propelled by two powerful 30-horse-power motors. In front of the car is a revolving wheel which breaks up the snow-crust completely, and behind are revolving brushes which sweep the tracks clean. It is estimated that this 'working-car' will clear a street-railway track after a heavy storm more quickly than the ordinary snow-plough drawn by 12 horses.

The system of wiring which the West End management has adopted for the crowded city streets is the Bentley-Knight conduit, now in use in Allegheny City, Penn. Here the conduit is laid midway between the tracks, and is strongly bolted to the stringers and sleepers. Its cross-section is about a foot square, and its upper part has a slot similar to that used in cable-railways ; its width, however, being only five-eighths of an inch, giving an opening so small that carriage-wheels will not catch in it. Besides this, it is so bevelled that horseshoe calks will not be held in it. Copper bars an inch and a quarter thick, one on each side of the slot, firmly insulated beneath it, carry the current, — one from the dynamo, and the other returning from the motors. The current is taken from the conductors to the motors by 'ploughs,' as they are called, two to each car. These ploughs are thin iron plates about ten inches square, hung from a framework over the middle of the track, and projecting into the slot. The motors are connected by controlling-switches, and the car is operated substantially as is the overhead system. The ploughs are so arranged that they can be lifted out of the slot when any obstruction is reached. The current is taken up and returned by spring-plates, which slide along the copper conductors at the bottom of the plough.

In switching, two ordinary tongue-switches are used, — one in the conduit, and one on the rail. Brushes attached to the snow-ploughs and cars easily keep the conduit and tracks clear, even in the severest snow-storm or in case of slushy and muddy weather.

The change from the overhead system to the conduit is made while the car is in motion, and without the slightest delay in travel or inconvenience to passengers ; so that the Sprague cars run over the entire distance.

The kind of truck used upon this road is the latest Sprague improved truck, which has been fully described in these columns. The equipment of this truck includes the new Sprague 'Boston' motor, which will be used, for the first time in commercial work, upon this road.

BEACON STREET, WEST FROM HARVARD STREET.

MOHAMMEDANISM AND SLAVE-TRADE IN AFRICA.

THE recent events in Africa have shown the enormous power Mohammedanism exerts in that continent. The growth of the empire of the Mahdi, the foundation of states by the Fulbe, the steady progress of Mohammedanism in the Galla country, prove its vast historical importance in Africa. We have shown on the accompanying map the distribution and growth of Mohammedan power in Africa according to an interesting study by A. Oppel, published in the Journal of the Geographical Society of Berlin.

Christianity early penetrated into Egypt, and from this point spread rapidly up the Nile as far as Abyssinia, and all over the north coast of the continent. In Egypt many of its dogmas were developed under the influence of Alexandrinian philosophy, while some of the ceremonies of ancient Egyptian worship found their way into the Christian cult. Here, also, many dogmatic controversies originated, which were the cause of long-continued wars. The Christian Church in Africa disintegrated, and at the same time was degraded by assimilating numerous heathenish elements. When, therefore, Mohammedanism first entered African territory, the ancient Christianism was swept away. In 640 A.D., Omar's general, Amru Ibn al Assi, invaded Egypt, which had been a province of Byzantium, and in 641 conquered Alexandria. In order to secure his hold upon the newly conquered province, Omar settled a number of Arabian tribes in Egypt, and through their influence numerous natives adopted the Mohammedan faith. Amru next subjected the western borderland of Egypt, and his successor, in 664, conquered Fezzan. In 711 the whole of North Africa was under Arabian sway. The native Berbers as well as the descendants of the Greeks and Romans, soon adopted their faith and language.

In the sixteenth century the power of the Berbers had increased considerably, and by acknowledging the authority of a Berber caliph they became independent of the Oriental Empire. As the number of Arab immigrants was originally small, they began to be merged into the Berbers ; but in the middle of the eleventh century several nomadic tribes who had lived in upper Egypt

emigrated westward, and penetrated far into the interior, thus giving Mohammedanism and Arabian influence a new impetus. In the beginning of the eleventh century the new religion had reached the great northern bend of the Niger, and since that time this region has been one of the central points and strongholds of Mohammedanism, and at one time the seat of high culture and of science. It seems that about this time the Fulbe adopted Mohammedanism. Arabian immigrants began to settle also on the eastern slope of Abyssinia. They intermarried with the natives, and founded a Mohammedan empire. The progress in Central Sudan was steady. About the year 1600 Baghirmi had become a powerful Islamitic state, and a little later Wadai had embraced the same faith. While in the eighteenth century little progress was made, a new period of advance dates back to the early days of our century, when the Fulbe, led by the fanatical priest, Otmann dan Fodio, attacked the heathenish Haussa States, and subjected them. The two states Gando and Sokoto, and, later on, Adamaua, which forms a portion of Sokoto, were founded. On the upper Niger Mohammedanism made progress in consequence of the uprising of the fanatical marabout El Hadj Omar, who subjected the region on the upper Senegal and Niger, and converted a great part of the Mandingo.

The Arabian supremacy over the east coast of Africa, which was first gained about 1700 A.D., was lost again in consequence of disagreements among the conquerors; but about the end of the last century the Sultan of Oman made an effort to re-occupy the coast, which has been held by the Arabs since 1838.

We have thus outlined the limits of Mohammedan Africa. Mohammedan traders, however, penetrate much farther into the interior, and with them the devastating slave-trade. It will be seen from our map that the area of slave-trade in a general way adjoins the Mohammedan area, and that it has almost invariably its outlet in Mohammedan countries. The demand for slaves arises principally from two sources, — from the domestic wants of the Mohammedan peoples, and from the necessity of obtaining carriers for the ivory-trade. In describing the extent of this trade we follow A. J. Wauters's sketches in the *Mouvement géographique*.

In the period following the Conquest and the establishment of plantations in America, the American land-owners who needed workmen began to import slaves from the west coast of Africa. Some figures will best show the extent of this trade. In 1600 the government of Philip II. made a treaty with the governor of Angola, according to which the latter engaged to furnish to the Spanish colonies 4,250 slaves annually. The price paid for this monopoly was 162,000 ducats. In 1701 this monopoly was held by the Portuguese Guinea Company, who had to furnish "10,000 tons of negroes" annually. The number of slaves furnished by the various companies holding the monopoly increased steadily, and in 1786 not less than 38,000 slaves were imported into Spanish America. From 1811 to 1820 Cuba received over 116,000 negroes, and in Brazil as many as 50,000 were imported in 1849.

From these figures it is easily understood why, even at the present time, many parts of the west coast are still depopulated. One of the principal regions of slave-hunting was the lower Kongo, whence, according to Monteiro, 100,000 slaves were exported annually. The trade on the east coast was not less flourishing, the principal market being Zanzibar. As is well known, this maritime trade has ceased to exist. Owing to the abolition of slavery in all Christian countries, the demand, and at the same time the necessity of supplying it, have ceased. On the east coast it has also become very insignificant owing to the endeavors of European nations, except on the coast of the Red Sea, whence Arabia and Persia continue to be supplied.

While thus Africa has ceased to supply foreign markets, the internal demand continues to be very large, and causes the continual spread of the area devastated by slave-hunters. We may distinguish four areas, — the western Sudan, the upper Nile, the lake region, and Lunda.

In western Sudan the sultans of the Haussa States frequently wage war upon their southern neighbors in order to obtain slaves, which are used for paying tributes, for building new residences, or for sale in order to fill the treasuries of the states. Kuka, the capital of Bornu, west of Lake Tsad, is one of the important slave-markets. Rohlfs states that he saw there a caravan of four thousand captives, which was about to be sent northward for sale. The surplus of slaves of this region is sent across the Sahara. For a long time Morocco was the chief consumer of these slaves, but the trade with that country is declining. Fifteen years ago Rohlfs estimated the annual import at ten thousand heads. The trade with Egypt has almost ceased, but now and then caravans reach its western boundary. Thus in 1871 a convoy of two thousand slaves arrived from Wadai, and even as late as 1880 slaves were sent there from western Sudan.

In eastern Sudan the slave-trade is not less flourishing, but here it is due to other causes. The region devastated by it embraces Bahr-el-Gazal, Jebel-Nuba, Dar-Fertit, and the country of the Shilluk and Niam-Niam. The ivory-trade created here the demand for slaves. Every year the merchants of Khartum sent armed expeditions into this region in order to collect ivory. These expeditions ascended the Nile, and began their transactions in the region of the tributaries of the Bahr-el-Gazal. They established at short distances stockades, called 'seribas,' which served as the basis of their operations. They subjected the natives, and compelled them to serve their purposes. In course of time these seribas became centres of slave-hunting, the negroes being not only compelled to assist in the ivory-hunting expeditions, but being exported for sale. During the time of Gordon's administration there was a slight relax; but, since the Mahdi has obtained control of the whole region, slave-hunting is once more flourishing. It is estimated that annually 30,000 slaves are taken from this region. This state of affairs is the more to be regretted, as this is one of the most densely populated and highly cultivated regions of Africa. The slaves are sold to the upper Nile provinces, Nubia, upper Egypt, and Darfor. They are also sent to the Red Sea, whence they are exported to Arabia.

At the present time, particular attention is called to the slave-trade in the Tanganyika basin and on the upper Kongo. Tabora, Udjidji, and Nyangwe are the principal markets in this region. It is only since a recent date that this territory has been devastated by the Arabs. Towards 1830 they reached Tabora in extending their commercial enterprises inland, and in 1840 they established a factory on the Tanganyika. In 1868 they had reached Nyangwe on the upper Kongo. From 1830 to 1870 immense caravans of slaves were transported to Zanzibar, and large tracts of land were devastated. The endeavors of the European nations to prevent the exportation of slaves have suppressed this export, but the ivory-trade still demands enormous numbers of carriers. The Arabs in Africa are also agriculturists, and enslave negroes in order to cultivate their fields. To fill these demands, they continue their razzias, and these are of course most devastating in territories into which the Arabs have recently penetrated, and where they have no workmen at their disposal. As soon as new means of transporting the ivory from the interior to the coast are found, the slave-trade will become less extensive. For this reason it is to be hoped that the Kongo Free State will soon succeed in opening a regular service between Stanley Falls and Leopoldville, as this will save the upper Kongo basin from a great part of the devastations of the slave-trade.

The last important territory subjected to the ravages of slave-hunters is the empire of Lunda. Here Portuguese half-breeds take the place of the Arabs of East Africa. It seems, however, that, in consequence of energetic measures of the Portuguese Government, this trade will rapidly decline.

It is to be hoped that the steps recently taken by many European nations to finally suppress the export of slaves will tend to diminish the demand; but a total suppression of the slave-trade cannot be effected without new means of communication in Central Africa. The social institutions of Mohammedan North Africa are such, that any attempt to prevent slave-hunting in western Sudan must fail, as it is impossible to influence the peoples who create the demand for slaves.

THE Congress of Americanists, composed of some of the most distinguished scientists of Europe engaged in the study of the prehistoric nations of America, which recently completed a very important and successful session in Berlin, voted to meet in Washington in 1890.

MENTAL SCIENCE.

Brain and Sociability.

THIS is the title of an address delivered at the Congress of German Naturalists of this year, by Prof. Theodore Meynert, whose works on the nervous system have given him a world-wide reputation. Like much that he writes, it contains many digressions, and in particular enters into details concerning the nature of instinct. The portion of the address most germane to the title is reproduced in abstract here.[1]

The struggle for existence has its origin in the tendency of organisms to multiply indefinitely. Sociability consists in the moderation of this strife; in the more or less conscious resolve of a certain portion of the animal kingdom to live and let live. The Hindoo philosophy attempts to embrace the entire animal world under such a law, but this is practically impossible. The Christian ideal of a single brotherhood of man is realizable, because it includes but one animal species. Such communities confined to one species, or still more frequently to one society, are to be seen in the animal world. The organized troops of elephants, the communities of ants and bees, illustrate it abundantly. With what kind of psychic or physiological activity to connect these manifestations is a question capable of various answers. One finds it difficult to draw the line separating the conscious from the unconscious, the designed from the instinctive, the voluntary from the reflex. It is somewhat less hopeless to arrange organisms by means of an anatomical comparison of their nervous systems. This would not coincide with the zoölogical scale throughout; for the *Amphioxus*, though a vertebrate, has almost no brain. By the classification here adopted, the ant and the bee would stand high in the scale. In man the cortical organ is situated to one side, the reflex organs to the other side, of the base of the cranium; and the ganglia furnishing communication with the organs of sense are between. In the same way in the invertebrates the ganglia anterior to the œsophageal arch are subordinate to those posterior: they play the *rôle* of higher and lower brain, and have the same significance as voluntary and reflex action have in the vertebrates. In the ants, according to Forel, the greater the intelligence of the animal, the more developed are these ganglia. Passing upward from the leech to the water-beetle (*Dytiscus*), to the ant, one passes from a nervous system in which the inferior cerebral ganglia are larger than the superior, to one in which they are equal, to one in which the superior gains the ascendency. Forel finds among ants that these ganglia are much reduced in the incapable males, a little larger in the females, and well developed in the workers. While consciousness need not be exclusively connected with these anterior ganglia, their high development eclipses the powers of the lower centres; and this seems to be the more perfect the greater the excess of the superior over the inferior ganglia.

The methods by which the sociability is retained among animal communities, — the power of communication, the power of recognition of friends and enemies, the selection of a single queen so that there shall be unity in the government, — all this need not detain us here. The point to be noted is the type of sociability represented by an insect community, — a sociability limited in its scope, but within that limit rendering the struggle for existence less keen. An ant of another species is treated as an enemy: degree of resemblance determines communism. Sympathy is not developed among the lower animals. Nutrition is the prime object of each. The most common dependence of one animal form upon another is parasitism. Parasites have been divided into those that do not feed upon the animal itself but take its nutriment, those that make return for what they take, and parasites proper. Parasitism in general is the anti-social characteristic both in animals and men. Its most perfect expression is 'slavery;' while 'reciprocity,' 'mutualism,' is the essence of all sociability, and is the ideal towards which civilization is striving.

From this general point of view the enemy of sociability among human communities, that is crime, is nothing but a form of parasitism. This it is that binds together criminals of all grades and nations. It is a lack of the true social instinct. In the natural development of the child, one can distinguish two *egos*. The primitive *ego* is formed by the consensus of sense-impressions, the motions, the pleasures and pains, yielded by its environment; and its activity is directed to the preservation of itself. Upon this is built a second *ego*, which, however, is not limited, like the earlier. It unites the individual to other men: it makes one share the life of all. It founds societies, and is the true germ of 'mutualism.' It contributes its activity to the general welfare of all. This wide scope of the secondary *ego* is gained by an increase of intense cerebral work. Its motives of action become so complex and so many, that the mind can no longer contain them. It brings about an ethical, a social feeling, that prevents what is harmful to the community, and opposes it.

The deprivation of a moral sense would thus be a kind of imbecility. It is a deficiency in the secondary *ego;* it reduces an individual to the stage of childhood in which self-preservation is the only end. The criminal retains the parasitic nature of his infancy, feels his life to be different from those of his kindred, and is thus excluded from the sentiment of sociability except towards those like himself. In as far as this is a mal-direction, and not an absence, of the moral sense, it is subject to reformatory measures. Other forms of anti-social psychic conditions exist, such as mania and the entertainment of delusions. One can follow the mechanism of sociability into the brain. The anterior portions of the brain exercise a control over the lower centres, — those connected with the exercise of sense and the individual functions. The anterior brain, then, can be regarded as the organ of sociability. Its development increases the sense of 'mutualism.' The superiority of the lower centres brings about the anti-social characteristics. Here are centred the parasitical, purely personal tendencies.

[1] *Revue Scientifique*, Nov. 24, 1888.

NOTES AND NEWS.

THE growth of the electrical industry in a direction in which less has been done, perhaps, than in some others, is shown by the formation of the Anglo-American Electric Light Manufacturing Company of this city, for the manufacture of a storage-battery which they believe to have many merits. It is claimed that the accumulator they are making requires no washing-out from the time it is started till it is ready to be thrown aside; that it will last five years, which is guaranteed by the company; that it will yield 90 to 92 per cent of the current put into it; that it will not buckle or break; and that it requires no expert attendance. We hope to publish a description of the battery, with illustrations, at an early date.

— In *The Critic* of Dec. 15, Mr. O. B. Bunce has an article on 'Christmas Books,' in which he ascribes the greatest activity in the bookstores during the holiday season to the purchase of children's books, of the works of poets, essayists, romancists, and historians, of Bibles, prayer-books, hymn-books, and albums, and of numerous miscellaneous selections; the gay and sumptuous volumes, which occupy so large a place on the counters, which have been produced at such great cost and with so much watchful care, filling but a small part in the general bustle.

— We learn from *The Electrical Review* that an electrical locomotive is building at the New York Locomotive Works, in Rome, N.Y. The engine is to be operated solely by electricity, and is designed to run on all roads where steam is now used. It will weigh fifteen tons, and when turned out of the shop will be an exact counterpart of an ordinary locomotive, though considerably smaller and lighter. When finished, an electrician from New York will take charge of it, and place in it the electrical apparatus to be used as a motive power. The inventor is W. H. Darling of Brooklyn.

— Recent experiments with a submarine boat, 'Le Gymnote,' made at Toulon, have been very successful. The boat moves horizontally as well as vertically, and is easily kept at any depth that is desired. It can be run at a speed of from nine to ten knots. The light is good, and respiration easy. Its crew is ordinarily three, but during the experiments five persons were on board. The *Revue Scientifique* says that the new boat, an invention of Mr. Krebs, is a complete success, and will become of the greatest importance in marine warfare.

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CONTENTS:

We print at another place in this number a brief account of the spread of Mohammedanism in Africa. While we may consider its influence upon the heathenish tribes of Africa as detrimental, we must not underestimate its vast historical importance. People like the African aborigines are not roused to activity by the teachings of Christian missionaries; the appeals of the Mohammedan dervishes, which instigate their passions and arouse their warlike dispositions, are more likely to raise peaceful tribes to historical importance. The power of Mohammedanism to create commotions of vast historical importance has been frequently shown. It shows itself at present in the whole Sudan, and, notwithstanding the endeavors of all European nations, it is doubtful whether it will be possible to stay its progress and to redeem Africa from the curse of slavery. The existence of slavery is inseparably connected with that of the Mohammedan states. The present endeavors of the European powers which are directed against the East African slave-trade have some chance of success, as there are no inaccessible Mohammedan states in that region, and the slave-trade is kept up principally by a small number of individuals. Cardinal Lavigerie, to whom this movement is partly due, maintains that five hundred trained soldiers marching through the German territory by way of Unyanyembe to Udjidji, on Lake Tanganyika, could crush the slave-trade and disarm and forever disable the Arab slave-merchants; but slave-raids of some form or other will continue to exist until means of conveying goods from the interior to the coast have been found, making unnecessary the use of carriers. It seems, however, that the principal region of slave-trade, that of Sudan, must for a long time remain inaccessible to European influence.

THE ADVANCES IN ELECTRICITY IN 1888.

When we contrast the present state of electric science and industry with their condition a year ago, we are struck with the remarkable advances that have been made, especially in the latter. The most important experiments bearing on the theory of electricity have been those of Hertz on the propagation of electrical disturbances, with investigations by various workers on the effect of light on various electrical phenomena. Hertz has obtained electric oscillations of a very short period, — several hundred millions in a second, — and he has shown that electro-magnet waves caused by them are propagated in the surrounding space, and are reflected and interfere with one another as do waves of light. To those who have not believed the electro-magnetic theory of light, these experiments will be of great importance: for those who have believed the theory, they will add corroborative and strengthening evidence. Our general views of the electric current have been gradually changing; and the idea of the energy of the current being transmitted through the surrounding dielectric, and entering the wire at every point, is changing our methods of treating problems of current propagation and our conceptions as to the mechanical reality that underlies the phenomenon. A number of experiments on the discharge of condensers have been made, notably by Professor Lodge, with a view of developing a theory of lightning, and of providing the best means of guarding against lightning-strokes. There grew out of Professor Lodge's experiments a warm discussion before the British Association, on lightning-conductors, in which there was shown a wide difference of opinion between 'theoretical' and 'practical' men as to the best means of protection against lightning, and the interest aroused promises to be the means of adding largely to our knowledge on the subject. The development of the alternating system of electric lighting has stimulated investigations in that direction, and a number of experiments on self and mutual induction, on induction-coils, etc., have been made.

In the application of electricity the advance has been much more striking, especially in this country. In lighting, the increase in the number of lights has been steady and rapid; and, although no radical improvements nor fundamental discoveries have been made, yet the efficiency of all of the lighting systems has been increased, and the expense reduced. In arc-lighting there have been only changes in detail of the important systems; but the number of new stations being equipped, and that have started in the last year, greatly exceeds the showing made in 1887. Incandescent lighting has progressed still more rapidly. The Edison Company has erected central stations of large capacity — up to a maximum of 50,000 lamps — in New York, Philadelphia, Chicago, and other cities, besides adding to the already long list of smaller stations. They have increased the efficiency of their incandescent lamps, and have perfected their dynamos. The returns of stations using this system have been for the year most satisfactory, and it is stated in some of the technical papers that a large amount of capital — no less than ten million dollars — has been subscribed abroad for the extension of the system. The number of electric motors that have been supplied from central stations has also largely increased. The Westinghouse Company has continued to distribute electricity by the alternating system, and has rivalled the increase of the older Edison Company. The advantages of their system for distributing to scattered points, and even in cities where overhead wires are allowed, and where the lights are not concentrated in a particular neighborhood, — the lighting of stores, halls, theatres, etc., — are apparent. The efficiency of their converters and lamps has been increased, and experiments are being carried on with a view to perfecting some motor that can be used on alternating circuits. Other companies are doing a great deal of business in a quiet way in putting in private installations for factories, offices, etc. There has

been much rivalry in electric lighting, and three of the most important companies — the Edison, the Westinghouse, and the Thomson-Houston — are at swords' points, and much of the current technical literature consists of discussions as to the merits and demerits of the various systems.

But it is in the extension of power-distribution by means of electricity that the year has been most memorable. Large numbers of electric motors have been installed for supplying powers from $\frac{1}{10}$ to 40 or 50 horse-power, and these are fed from the local lighting companies, and have displaced small steam and gas engines. The uses to which they have been applied are innumerable, and they are increasing in favor as their economy and efficiency become more apparent. More ambitious installations have been carried out in the Western mining districts; the most noteworthy being the power plants at Aspen, Col., and on the Feather River in California, where the Sprague Company has transmitted power (in the last case a distance of nine miles), and at Virginia City, where the Brush Company has just effected an installation. Electric street-railways have more than kept pace with stationary motor-work. The first large road equipped was the Richmond road of the Sprague Company, the largest and most difficult installation that had ever been attempted. After numerous disappointments, and after overcoming difficulties that would have disheartened any less energetic and efficient company, the road was successfully opened in March, and has been running without interruption ever since. There is little doubt that to the success of this tramway is due the boom in electric-motor cars, that has given the Sprague and other companies a business even greater than their large capacity. The Sprague Company has finished or is equipping thirty street-railways; the Thomson-Houston Company, as many more; while the Daft Company has under way or finished a dozen or fifteen. All of these roads have overhead wires to convey the current from the dynamos to the motors. It is probable that the ultimate system of street-car traction will be by storage-batteries on the car, supplying current to motors beneath them, geared to the axles. During the year there has been little progress in this system of traction. One or two cars are being run in New York, in Philadelphia, and in some of the Western cities. The progress has hardly, however, been satisfactory. The present type of storage-cell is heavy and inefficient, and rapidly deteriorates; and the year has not seen the introduction, either here or abroad, of any new type of battery, nor any marked improvement in the old. For exceptionally favorable roads, where there are very light grades, storage-battery cars will cost about the same as horses, or perhaps a little less; but there are few such in the States.

No important inventions in industrial electricity have been developed during the year, although several very promising ones have been patented, and are being improved and tested. The Tesla motor for alternating currents is being developed by the Westinghouse Company; several plans for continuous-current conversion are being experimented on; new types of storage-battery have been described, and will possibly prove successful. Nothing important has been done in the telephone line. In telegraphy Professor Gray has developed a writing-telegraph, which will possibly do what is claimed for it, but which seems very complicated.

There has been much patent litigation, and important decisions have been rendered here and abroad. In an English suit Edison's fundamental patent on carbon filaments for incandescent lamps was badly damaged, although the decision has been appealed from, and it is again being tried. The patents of the Westinghouse Company for the alternating system have been decided against, both in England and this country. The Supreme Court has decided that the government has the right to bring suit against the Bell Telephone Company to annul Bell's patent, but this decision is of interest only as establishing the general right of the government to bring such a suit. A number of important suits are pending on patents for storage-batteries, incandescent lamps, systems of distribution, etc.; and after the holidays a case before the Supreme Court will decide whether Edison's fundamental patents on electric lighting have expired with the limit of the foreign patents.

On the whole, the year has been one of solid advance and improvement, but with no startling development nor revolutionary discovery.

THE SCIENTIFIC WORK OF THE JOHNS HOPKINS UNIVERSITY.

IN considering the scientific work at the university, President Gilman laid emphasis, in his recent annual report, on those parts of the work which are of widest interest, especially on the investigations and publications which have been encouraged, and the opportunities afforded for the education of advanced students. The trustees and the faculty of such an institution need frequently to recur to general principles, ask themselves what they have undertaken to do, and carefully weigh the results of their labors. Accordingly a brief restatement of some of the considerations by which they have been influenced introduces the record of the year. Far more important than the formal lectures and recitations of a university are the intellectual influences which it affords, — the attractions of its libraries and laboratories; the spirit which animates the professors; the conditions upon which degrees, fellowships, and other academic honors are bestowed; the connection existing between the studies of the place and the studies that are in progress in other seats of learning; and the prospects which are open to young men of character and scholarship at the end of their courses. The university which imparts to a large number of students good impulses, disciplines them with thorough training, encourages them with judicious counsel, and upholds before them lofty ideals, becomes an agency of great power in the advancement of the general welfare. It annually sends to every part of the land, into all the professions, into professorships, masterships, and other leaderships, those who are likely to be centres of light and influence in their various states.

The opening of this university occurred in 1876, at a time when many careful writers were engaged in the study of the progress of the United States during the first hundred years of national life. Important articles then published, on the state of the arts and sciences in America, and on the condition of American education, were carefully considered by those who were engaged in planning the new institutions in Baltimore. Among such papers there was one entitled 'Abstract Science in America,' by Professor Newcomb, which indicated "the points of view from which our claims to be an intellectual nation look very slender indeed." The writer acknowledged the excellent quality of the work which was done by the leaders of American science, while he lamented the want of encouragement to engage in such labors. He declared that "we are deficient in the number of men actively devoted to scientific research of the higher types, in public recognition of the labors of those who are so engaged, in the machinery for making the public acquainted with their labors and their wants, and in the preliminary means for publishing their researches." He continued to say, —

"Each of these deficiencies is to a certain extent both cause and an effect of the others. The want of public recognition and appreciation is due partly to a want of system and organization, partly to the paucity of scientific publications. The paucity of research is largely due to the want of adequate reward in public estimation and recognition; while the paucity of scientific publications is due to the want of an adequate number of supporters. The supply of any one of these deficiencies would, to a certain extent, remedy all the others; and, until one or more are so remedied, it is hopeless to expect any great improvement. In other intellectual nations, science has a fostering mother, — in Germany the universities, in France the government, in England the scientific societies; and, if science could find one here, it would speedily flourish. The only one it can look to here is the educated public; and, if that public would find some way of expressing in a public and official manner its generous appreciation of the labors of American investigators, we should have the best entering wedge for supplying all the wants of our science.

"The other way in which help could be most effectively given at small expense is by the support of two or three first-class journals of exact science. We say exact science, because this is the department which is worst supplied in this respect. Taking mathematics at one extreme, and medicine at the other, we can pretty accurately gauge the exactness of each science by the difficulty its cultivators find in supporting journals devoted to it. It may seem like reducing our thesis to the ridiculous to say that our wants in this

respect could be well supplied at a cost of five or six thousand dollars per annum, and that the future prospects of the mathematical sciences in this land depend very largely on their cultivators being able to command this annual sum for the purpose indicated."

In two of the particulars just mentioned — the encouragement of advanced studies and the publication of results — this foundation has aimed to do its part. By precept and example, hundreds of young men have been trained in the methods of exact science and the habits of accurate investigators. Not a few of these students have been called into the scientific service of the government; many are engaged in laboratories, scientific and technical; more are employed as teachers in training up other young men. The university can point to no result of its efforts which is so gratifying, and which so thoroughly repays the outlays of this foundation, as the corps of graduates who have gone out to every part of the country, prepared to contribute to the progress of knowledge, and who are now rendering good service to science, literature, and education. By encouraging the publication of journals and monographs, this foundation has endeavored to supply another of the deficiencies referred to above. Five periodicals, devoted to mathematics, chemistry, biology, philology, and history, have been aided by the university chest; and three others, devoted to archæology, psychology, and modern languages, have been initiated on the personal responsibility of certain members of the academic staff.

President Gilman then considered the higher aspects of the work of the university, especially during the last session.

The subject of mathematics has received a large amount of attention in the years gone by, as every one knows who remembers the seven years' leadership of Professor Sylvester, the special courses given by Professor Cayley and Sir William Thomson, and the continued instruction of the present staff of mathematicians. Every one that has an appreciation of the nature of mathematical thought, or of its relation to the advancement of science, must rejoice that this has been so. Dr. Whewell once claimed that mathematics and civilization go forward hand in hand; and quite recently Lord Rayleigh, in reply to some contrary assertions, has said that although some mathematicians are unpractical, yet it is to mathematics one must go to find the results of known causes under new circumstances.

It has always been a surprise to President Gilman that so few Americans are interested in the new and advancing developments of this science, and that so large a number of those who are giving their lives to mathematical professorships prefer to walk in well-trodden paths without attempting to follow the higher flights of the leaders. The number of mathematical students at Johns Hopkins has never been large; but the teachers continue to offer varied advanced courses attractive to a superior class of students, and those who graduate in this subject are not often obliged to wait for a vocation. In addition to the usual number of mathematical lectures, stated in the appendix, there has been a noteworthy advance during the past year in the facilities for the study of astronomy, theoretical and practical, and there has been a considerable increase in the number of students.

An observatory for instruction is now provided. Besides the telescope mentioned in the last report, the university has purchased a meridian circle (made by Messrs. Fauth & Co. of Washington), with collimators, mercury basin, and other appliances. To receive this instrument, a special structure has been built adjacent to the physical laboratory. A class in practical and theoretical astronomy has been organized under the guidance of Prof. Simon Newcomb, for many years connected with the Naval Observatory in Washington, and now superintendent of the United States 'Nautical Almanac.' During the coming year he will be assisted by Mr. Charles A. Borst, lately one of the astronomical observers of Hamilton College, who has received the appointment of a fellow.

From these statements it is apparent that the university is now provided with the most important of the astronomical apparatus suggested many years ago by Professor Newcomb, in one of his public lectures, as desirable for the practical instruction of astronomers. It has also the qualified teachers, and a company of students has begun the prescribed course. The further development of this department of study will be watched with great interest. Its distinctive character is its adaptation to the needs of young men, already proficient in mathematics, who need to be trained in the methods of astronomical inquiry, and who want easy and constant access to suitable instruments, as they have in the laboratories of chemistry and physics.

One leading idea of the work is to associate with the technical study of the subject a greater breadth of culture than can readily be gained by the student whose attention is wholly occupied by practical work in the observatory or the field. It is therefore intended that all students taking the doctor's degree in astronomy as their principal subject, shall have an understanding of the historic development of the science since its beginning, of the additions made to it by its leading cultivators, of the mathematical theories of the celestial motions, and of the practical use of the most important astronomical instruments.

The *American Journal of Mathematics*, of which Professor Newcomb is editor, and Associate Professor Craïg the assistant and managing editor, has completed its tenth volume, and an index of the contents of the entire series has been prepared for publication. Eight of the contributors to the tenth volume are Americans; four reside in England; four in France; and one each in Canada, Italy, and Germany.

The mathematical staff remains as it has been for several years past, Drs. Story, Craig, and Franklin being associated with Professor Newcomb.

The new physical laboratory justifies the expectations which led to its construction, not merely in view of the increased facilities it affords for instruction, but also for the greater efficiency with which investigations are carried on.

During the past year, Professor Rowland has continued to devote much attention to the study of the solar spectrum, and the preparation of a new edition of his photographic map. The new ruling-engine, which was completed a year ago, has been placed in the vault prepared for it, where the temperature is equable; and, after months of laborious adjustments and connections, the machine has been so perfected that it rules gratings of the largest size, surpassing in definition any that have been obtained before. Several concave gratings six inches in diameter, and with a radius of more than twenty-one feet, have been ruled with from ten to twenty thousand lines to the inch, and they have been mounted in a large room especially adapted to their service. It is chiefly due to the excellence of these gratings that the new photographic maps are so superior to the old. Something is due also to the constant attention Professor Rowland has given to photographic methods, and to his skill in making dry plates, simple and orthochromatic. The result of this long and laborious preparation has been the production of a map, soon to be published, of the normal solar spectrum, extending from the extreme ultra-violet (down to and including B) to wave-length 6950.

The director of the laboratory has been greatly favored in the prosecution of his work by the services of the associate professor in physics, Dr. Kimball, who has given for several years past the general course of instruction, and has personally guided the laboratory-work of the students.

The special course of instruction in electricity and magnetism has been in charge of Dr. Duncan, and it has been found to meet the wants of students who have an aptitude for both mathematical and experimental work. Four such persons, after a special course of study extending through two years, and after satisfactory final examinations, received special certificates at Commencement.

With the unusual facilities now enjoyed by Professor Rowland, it is natural that his principal work during the past year has related to the nature of light. Under his guidance, progress has been made in determining the absolute wave-length of light, and the relative wave-lengths of lines in the ultra-violet portion of the solar spectrum. The spectrum of hydrogen has been studied under various conditions of excitement and pressure; and the spectra of zinc, cadmium, and magnesium have been studied photographically and the wave-lengths measured. So, also, various bands of the carbon spectrum from the electric arc have been investigated, an algebraic expression of the relation between their wave-lengths has been obtained, and the coincidence of the bright lines of the carbon spectrum with the dark lines of the solar spectrum has been verified. Additional measurements have been made on the displace-

ment of lines in the solar spectrum due to the rotation of the sun.

Important work has also been going forward with respect to electricity and magnetism. A determination has been made of the unit of electrical resistance by the method of Lorenz, and a study has been made of the electrical resistance of pure mercury with reference to the value of the mercury unit. The curves of electromotive force and current in an alternating dynamo, under varying conditions, have been studied, and also the chemical changes in storage-battery cells, and the behavior of different insulating substances under various conditions.

Arrangements have been matured for the testing of electrical instruments and standards for other laboratories, scientific and industrial. This work, under the supervision of the chief instructors, is intrusted to Dr. Liebig. Correspondence between Dr. Duncan, associate in electricity, on one part, and the leading electric manufacturers and the professors of physics in different parts of the country, on the other, has indicated the need of such a bureau as is now established. Its actual utility will soon be demonstrated.

In this connection President Gilman writes: "I am unwilling to pass on from this subject without endeavoring to arrest the attention of the trustees, and through them the attention of other persons who are observing the development of this university, to the fundamental character of the researches which are here carried on, and to their ultimate relation to the welfare of human society. Costly laboratories, expensive apparatus, numerous assistants, the means of publication, unquestionably call for a great deal of money; and those who are concerned with economical problems have a right to ask what results are to be seen after all this outlay. The answer can readily be given with respect to all departments of science; but just now it is particularly easy to justify the expenses of a physical laboratory, because of the remarkable progress which is making throughout the world in the study of physical phenomena, and the discovery of principles hitherto vaguely perceived or entirely hidden.

"Those who are watching the progress of science are well aware that the year 1888 is memorable for the new evidence which has been brought to the support of Maxwell's electro-magnetic theory of light in the experimental discovery of long waves of electro-magnetic induction moving through the ether with the velocity of light. The papers of Hertz, presented by Helmholtz to the Academy of Sciences in Berlin, and the discussions to which they have given rise in the recent meeting of the British Association and in the scientific journals, are proofs of this remark.

"This is not the place for more than an allusion to such investigations; but some reference to them seemed called for, in order to show that there is constantly even now an advance. The conception of a Faraday, developed by the powerful analysis of a Maxwell, is submitted to the laborious tests of the laboratory; one after another agreements and coincidences are found; facts insignificant in themselves become weighty with importance when seen in their relation to others; and finally some far-reaching result, like that of Hertz, compels belief, and gives to the world a new truth as a part of its inestimable treasure of knowledge, enriching the intellectual life of all who come after.

"Another illustration may be found in the address of Professor Langley at the Cleveland meeting of the American Association. Under the title of 'The History of a Doctrine' (radiant energy), he has unfolded, in terms which are easily followed by 'the non-mathematical reader' (and even by the 'non-scientific'), the steps by which science has reached its present stage, and is still advancing in the discovery and interpretation of a fundamental truth.

"In this progress the work of a laboratory is most important. The photographic maps of the sun spectrum and of the spectra of metals, and the measurement of the wave-lengths of light, among the labors that have engaged our own investigators, relate directly to fundamental questions in physics and chemistry.

"The diffraction gratings devised by Professor Rowland are of prime importance in the prosecution of these studies of light. In all the principal laboratories of the world they are in demand, and consequently their manufacture is continued, although it requires a large amount of personal supervision from the director. The measurement of the mechanical equivalent of heat is a fundamental factor in establishing the doctrine of the conservation of energy, and lies at the basis of the modern theory of the steam-engine. So, also, the solution of problems in electricity and magnetism, besides giving glimpses into a realm of nature still enshrouded with mystery, has a direct bearing on the welfare of the race, by advancing that knowledge which enables mankind to make the forces of nature obedient slaves.

"My object in thus dwelling upon the returns which have come, and are likely to come, from large expenditures of intellectual force and of financial resources, is to invite attention to an opportunity for the endowment of 'the ——— Institute of Physical Science' in the Johns Hopkins University. The admirable laboratory that has been built and well equipped, from the mechanic's shops in the basement to the telescope in the tower, is in itself an enormous and complex piece of apparatus for the prosecution of researches. Its staff of teachers and investigators are constantly looking to the advancement of knowledge, and maintaining a helpful attitude toward the practical applications of science. A serviceable way to keep up and extend the efficiency of this laboratory would be to provide it with a fund of its own, to be perpetually and exclusively devoted to the advancement and diffusion of knowledge in this special domain. More than a hundred years ago an American citizen, well known as Count Rumford, established in this country and in England large funds for the promotion of investigations in light and heat. The good accomplished by his gifts is incalculable, and the lustre of his name increases as the years roll on. Who will follow his example?

"If there are any friends of the university who are anxious to know what are the practical results of abstract science or of recondite and to them incomprehensible researches respecting energy, let them read these words of Professor Langley, 'The doctrine of radiant energy is reaching out over nature in every direction, and proving itself by the fact that through its aid nature obeys us more and more, — proving itself by such material evidence as is found in the practical applications of the doctrine, in the triumphs of modern photography, in the electric lights in our streets, and in a thousand ways which I will not pause to enumerate;' or these words of Professor Fitzgerald,[1] 'Let us for a moment contemplate what is betokened by this theory that in electro-magnetic engines we are using as our mechanism the ether, the medium that fills all known space. It was a great step in human progress when man learnt to make material machines, when he used the elasticity of his bow and the rigidity of his arrow to provide food and defeat his enemies. It was a great advance when he learnt to use the chemical action of fire; when he learnt to use water to float his boats, and air to drive them; when he used artificial selection to provide himself with food and domestic animals. For two hundred years he has made heat his slave to drive his machinery. Fire, water, earth, and air have long been his slaves; but it is only within the last few years that man has won the battle lost by the giants of old, has snatched the thunderbolt from Jove himself, and enslaved the all-pervading ether.'"

The work of the chemical laboratory, having been well organized for a longer period than that in physics, calls for less comment. Professor Remsen continues to be the director, and Dr. Morse the sub-director, and Dr. Renouf and several younger men are engaged as assistants and teachers. If increasing numbers are an indication of success, there is every reason to be gratified, for during the past year every available place in the laboratory has been occupied. But numerical success is not the best test of any branch of university-work. The readiness with which the young men who have here been taught are called to good positions, sometimes as teachers and sometimes as chemists in technical occupations, is an indorsement more significant than any numerical statement. All the arrangements of the laboratory are adapted to those who desire to devote a long period of time to this study, and those who wish for short and special courses are not encouraged to come here. Three or four years of study is usually required of those who have had already such an undergraduate course as is here given, before they can proceed to the degree of Doctor of Philosophy. The director of the laboratory continues to edit the *American Chemical Journal*, which has now nearly reached the conclusion of its tenth volume.

[1] Address at Bath, Eng., September, 1888.

and has taken its place among the chemical journals of the world as the chief repository of what is accomplished in this country for the advancement of the science.

The geological work in progress at the university is in part petrographical, in part structural, and in part paleontological, in its nature.

The study of interesting chemical and microscopical problems relating to the alterations which certain minerals undergo in the earth's crust, commenced by Dr. Williams five years ago (in the black gabbros occurring west of Baltimore), and published as Bulletin No. 28 of the Geological Survey, has since that time been pursued in widely separated regions. One series of articles on analogous rocks occurring near Peekskill, N.Y., has already appeared, while an extended memoir on similar phenomena observed in the Lake Superior region is now passing through the press in Washington.

At the present time all the varied and complicated crystalline rocks of Maryland, occupying an area of two thousand square miles, are being mapped upon a scale of two inches to the mile. This work has been undertaken in connection with the United States Geological Survey, and is under the direction of Dr. Williams. Chemical and microscopical studies of the rocks are carried on in connection with the field-work.

Dr. W. B. Clark, who has been connected with the university during the past year, is engaged in original research in paleontology.

In response to a request from the university, Major J. W. Powell, director of the United States Geological Survey, has caused to be made a survey of Baltimore and its environs, in general conformity with the scheme which is in progress for making a topographical map of the entire country. The survey of the Baltimore region was intrusted to Mr. Sumner H. Bodfish, topographer of the survey, assisted by Mr. J. H. Jennings, assistant topographer of the survey, and Mr. E. G. Kennedy, and the work is now nearly ready for publication.

The past year has seen improved organization in the department of psychophysics, and likewise the unexpected interruption of its activity. Suitable rooms for experimental work were provided in the physical laboratory, instruments and apparatus were bought, and the services of an associate well trained in the methods of physiological inquiry were enlisted. Arrangements were perfected for clinical observations and for the examination of pathological conditions of the nervous system. Nor were the wider aspects of psychology neglected; the history of philosophy and the principles of pedagogics were taught. The publication of the *American Journal of Psychology* was begun, with the financial encouragement of a liberal friend. An increasing number of well-qualified students were attracted by the learning, the enthusiasm, and the sympathy of Professor Hall. Near the close of the academic year, he received an invitation to become the head of Clark University. No successor has as yet been nominated.

Since the foundation of this university, the biological sciences have received special encouragement, partly because of the rapid advances that they have been making, and partly because of their relation to the progress of modern medicine. Prolonged courses of training are arranged for those who propose to devote their lives to investigation or to teaching in these branches, as well as for those who intend at a later period to study for the profession of physicians and surgeons. As in physics and chemistry, abundant facilities for laboratory-work are called for; instruments, materials, and assistants have been and must be liberally provided.

The science of biology includes the study of the forms and functions of living beings in their normal conditions, or, in other words, physiology and morphology; and in both these departments animal and vegetable life must be studied. Professor Martin, director of the biological laboratory, gives his chief attention to physiology; and Dr. Brooks, director of the marine laboratory, to morphology. Dr. Howell, now associate professor, is the chief assistant in biology; and during the past year aid has also been received from Dr. Andrews, Dr. Barton (in botany), and others.

In considering the work of the session, mention will be first made of the courses that are planned for beginners. The director believes that such students have never been more efficiently taught than during the past year, and the result is indicated by an increase in the number enrolled for the session of 1888–89. When it becomes understood that a medical education should always be based upon an intimate acquaintance with the laws of life and the activities of normal and healthy beings, young men will not fail to avail themselves of such preliminary training as is here afforded; but, as most of the medical schools of this country prescribe no conditions of scholarship as essential for beginners, it is no wonder that the number of future physicians who are willing to take preparatory instruction in biology is small. It is a great satisfaction, however, to observe that those who have this thorough foundation rise surely and quickly to professional excellence.

The results of many of the original researches in the department have already been published in abstract in the *University Circulars*, the *Zoologischer Anzeiger*, and elsewhere; some of the remainder have been published in full in the *Studies from the Biological Laboratory* and in other journals.

Three numbers of the fourth volume of *Biological Studies* were printed during the year; and a volume containing Dr. Bruce's observations on the embryology of insects and arachnids was issued with the co-operation of his friends in Princeton.

The unusual opportunities which have here been provided for students to become acquainted with the most recent methods of pathological investigation are but little known, partly because of their novelty, and partly because pathology has been usually regarded as a branch of a distinctly professional education. Looking forward to the time when a medical school will be organized, — in close relations to the Johns Hopkins Hospital, on the one hand, and to the philosophical faculty of the university, on the other, — the trustees in 1883 determined to supplement the physiological work already directed by Dr. Martin, with a new department of pathology, in which the most recent and approved methods of research should be introduced. Dr. William H. Welch of New York was appointed professor of this science, and, after a year's residence in Europe, he began the organization of a laboratory in a building (that had been constructed for autopsies) on the grounds of the Johns Hopkins Hospital. All the apparatus required for such investigations has been provided by the trustees. Cultures of a large number of pathogenic micro-organisms have been collected, and likewise a great deal of material illustrative of human and comparative pathology. The laboratory is open and teachers are present during the entire day.

Instruction is given in general pathology and in the special pathological histology of all the organs of the body, in experimental pathology, and in the method of making autopsies. Bacteriology receives a great deal of attention. Students are taught to study the forms, growth, and functions of bacteria and fungi, particularly those which are related to disease. They have also an opportunity to become acquainted with the methods of biological examinations of air, water, etc. There is hardly any branch of human knowledge which is growing so rapidly, and which gives promise of such good fruit, as that which includes the laws of life in health and disease. Education for the medical profession of this country must soon be re-organized in accordance with modern developments. In this re-organization laboratory methods are to play a most important part; and young men who have been trained in physics, chemistry, and general biology are coming up to the school of medicine ready for further scientific studies, especially in the laboratory of pathology. Here, among other subjects, they must be taught the relations of bacteria to disease, and the changes in structure and in function produced by disease in the various organs and tissues of the body. They must be able to understand the discoveries now in progress, to weigh their significance, to see their bearing upon diagnosis and the treatment of disease. Hence it is that at so large a cost this university has given such vigorous support to its school of pathology, and has aimed to equip the laboratory so completely with the requisite apparatus and with the material needed for study.

Dr. H. Carrington Bolton is about to undertake a journey to Egypt. From January 1 to May 1, 1889, letters may be addressed to him, care of Brown, Shipley, & Co., London, England.

STANLEY AND EMIN PACHA.

WHILE the Arabs in Suakin were reported to have captured Emin Pacha and Stanley, news reached Leopoldville that Stanley had returned to the Kongo, and the indications are that this report is trustworthy. The first telegram was from Zanzibar, dated Dec. 21:—

"Letters dated Stanley Falls, Aug. 28, have been delivered here by Tippo-Tip's men. They state that a letter was received at Stanley Falls from Henry M. Stanley on Aug. 28. Stanley was then at Banyala, on the Aruvimi, where he had arrived on Aug. 17. He had left Emin Pacha eighty-two days before, in perfect health, and provided with plenty of food. Stanley had returned to Banyala for the loads of stores in charge of his rear guard, and intended to leave ten days later to rejoin Emin. He reported all the whites in the expedition as healthy, and said the expedition wanted nothing. In the Stanley Falls advices it is stated that Stanley wrote that Emin was in possession of vast stores of ivory and many oxen, and that he had an abundance of food. Stanley intended to leave Banyala at the end of August."

This was followed by another despatch, stating that these messengers came by way of Udjidji and Unyanyembe. They were said to confirm the other accounts, that Stanley had left Emin with Casati, and that both were perfectly well.

On Dec. 22 this news was amplified, and the following detailed telegram sent from Zanzibar:—

"One of the special messengers sent into the interior in October, in the hope of obtaining news of Emin and Stanley from caravans, has sent a despatch announcing that he met Arab traders from Wadelai, who positively affirmed that Stanley met Emin there about Jan. 20. Stanley, the traders said, had 330 men and plenty of stores. He had endured great privations, but he and all his party were well, although extremely exhausted. The delay in reaching Wadelai was due to difficulties encountered on the route, the expedition having to make a long détour toward the north-east in order to avoid swamps and hostile tribes.

"Emin was then in a fairly good position, although some of his Egyptian officers were grumbling, and many of his soldiers had deserted. The Kings of Uganda and Unyoro were hostile to Emin, who was obliged in November to repel predatory incursions from the east. His general health was good, but he had been suffering from an affection of the eyes for two months.

"A fortnight after Stanley's arrival, Emin received, *via* Lado, a message from the Mahdi pompously intimating his intention to subdue the whole country as far as the great lakes, and promising good treatment if Emin submitted. Emin replied that before evacuating he must wait for the Mahdi to prove the legitimacy of his claim to the province.

"Stanley, in the mean time, applied himself to restoring order among the troops, and distributing stores and munitions. Emin told Stanley that he did not desire to leave Wadelai. The entire route to the east coast was most dangerous on account of the incessant agitation among the tribes and the hostility of Mwanga. Toward the middle of April, hearing that a force of Mahdists was coming, Emin ordered his advanced posts between Dufile and Lado to retire to Wadelai, and Stanley sent messengers to the Kings of Uganda and Unyoro.

"About the end of April, when the traders left Wadelai, Stanley was anxious, owing to the absence of news from the rear guard on the Aruvimi, and was arranging to send a strong detachment in search of them along the route which he himself had followed. Stanley also again urged Emin to leave Wadelai with him and regain the coast. Stanley sent out several couriers with news for Europe. One was the courier who was sent by the foreign consuls at Zanzibar to apprise Emin of the departure of the relief expedition. This courier had remained at Wadelai, and was sent back to the east coast after the arrival of Stanley. Another courier was sent in the direction of the Aruvimi."

By a remarkable coincidence a despatch giving information of a similar character was sent from St. Thomas on Dec. 21, 2 P.M. It was stated that Stanley, with Emin Pacha, had arrived on the Aruvimi. This news was confirmed on the following day in a telegram to King Leopold of Belgium.

It would be interesting to learn the exact time when the detailed Zanzibar telegram was despatched. Former events show that reports received from West Africa were telegraphed to Zanzibar, and returned wonderfully amplified. It is at least worth remarking, that on Dec. 23 the London *Times* received a despatch from Zanzibar stating that "no details have been received here of the reported meeting of Stanley and Emin." The Brussels telegrams, on the other hand, have generally proved trustworthy regarding the main facts.

There can be no doubt that Stanley had reached Emin about the beginning of the current year, and that he has retraced his steps to the Kongo. The news does not disprove the alleged capture of Emin Pacha. We may hope to receive further and more detailed news in a fortnight or three weeks.

SCIENTIFIC NEWS IN WASHINGTON.

Ojibwa Folk-Lore.

DR. W. J. HOFFMAN of the Bureau of Ethnology read a short paper at a recent meeting of the Anthropological Society of Washington, entitled 'Notes on Ojibwa Folk-Lore,' in which a brief review was given of his researches among that tribe of Indians during the years 1887 and 1888. He has finally succeeded in obtaining the ritual, mnemonic songs, initiation and pictographic charts embracing the cosmogony, and institution of the Midéwiwin, or Grand Medicine Society, and of the Dji bai Midéwigân, or Ghost Lodge.

The former consists of four distinct degrees, each of which may be entered by one, if properly prepared by the necessary preliminary fasts and visions, progress and acquirement of information in chants and prayers, and proficiency in the skill expected of a Midé, or Grand Medicine Man.

In addition to this, life-size sketches were exhibited to show the facial ornamentation adopted, and recognized as characteristic of each degree. The 'Ghost Society' is an organization closely connected with the Grand Medicine Society, and is considered to be the "lodge in which the departed Midé meet, to hold sessions, and initiations of newly arrived spirits of Midè who occupied honorable positions among the Indians of this world." When a boy who had been dedicated to the Grand Medicine Society dies, his father or mother may become members of the first degree of the Grand Medicine Society through the representatives of the Ghost Society, this partaking of the character of a proxy.

All the information about these two societies is now in preparation for publication by the Bureau of Ethnology.

Teton Folk-Lore.

The following statements were made by Rev. J. Owen Dorsey, in a paper entitled 'Teton Folk-Lore,' read before the Anthropological Society. The material used in the preparation of this paper was translated by Mr. Dorsey from a collection of Teton texts, written by George Bushotter, a Dakota Indian.

The Tetons believe that the buffalo used to dwell in subterranean lodges. When one sees a buffalo in a vision, the animal becomes his guardian, rendering him almost invulnerable, putting a real buffalo inside of him, and conferring on him the right to take part in the buffalo dance. In the olden times there was also another species of buffalo, about which marvellous tales are told.

On one occasion some Indians were attacked by one of these mysterious animals, and one of the party was killed. But the monster walked four times around the corpse, and said, "Arise!" Immediately the dead man revived. The monster said, "Hereafter you shall be mysterious. The sun, moon, four winds, day, and night shall serve you." From that time the man could assume any shape.

Gophers shoot at persons with the tip end of a species of grass, wounding them in the neck, and causing scrofulous sores. Warts betray a thief. If the skin of the hard palate peels off, the person is given to lying. Whoever makes a practice of eating the large intestines of cattle (the *ta-ski-ya-ka*) is sure to "be hit by the *ski-ya-ka*;" i.e., he will have a boil. *Ski-ya-ka* is the name of the dabchick or grebe. The boil will be on some covered part of the body. The Tetons dare not go out on a windy night, lest the cause of

boils be blown to them. If a man eats the liver of a female dog, or a woman eats that of a male dog, the face will break out in sores. He who is given to eating the calves of the legs of any species of animals will have a cramp in the muscles of his own legs. Tetons are forbidden to wear women's moccasons, lest when they meet their foes they cannot run swiftly. Children are not allowed to put inverted bowls on their heads, because such a practice will make them stop growing.

Hunting-Lore. — He who steps in or on a bowl or dish will fail to wound any game: so dishes are turned upside down when not in use. When one wishes to extract the marrow, he must not split the bone in two. A violation of this custom will cause lameness or frequent pains in the legs. Whoever breaks marrow-bones awkwardly cannot become a good marksman. The shoulder-blade of a buffalo calf, or that of a doe, is hung on the outside of a tent, just above the entrance, to insure success to the hunter a day or two later.

Interesting University Statistics.

Among the statistical tables that are to accompany the forthcoming annual report of the Bureau of Education, none are more interesting than those relating to the universities, colleges, and scientific schools of the United States. They are more valuable than ever this year, because they are based upon more complete returns from the institutions, and their value is greatly enhanced by the very intelligent discussion of the tables by Miss Annie Tolman Smith of the bureau, who prepared them.

One suggestive table gives the statistics of twelve of the leading institutions of the country. They are Yale, Columbian University (Washington), Johns Hopkins (Baltimore), Boston University, Harvard, Dartmouth College, College of New Jersey, Cornell University, Columbia College (New York), University of the City of New York, University of Pennsylvania, and Vanderbilt University (Nashville). Of this table, it is remarked that the foundations of the institutions named "illustrate every source from which the material equipments of the highest order of institutions are likely to arise, excepting State or national bounty. All of them have progressed far enough to be judged by their actual work, and nearly all of them have achieved more than national distinction.

"The undergraduate work of five of these institutions is carried on in colleges of arts and schools of science having their distinct faculties and students; in three, schools of science have distinct recognition, although the faculties and students are not reported separately from those of the college of arts; in the remaining four, the undergraduates are classified by the subjects or courses of study pursued.

"Graduate departments, not professional, are reported from ten of the institutions. Seven of the ten report also professional schools, as do the two that do not report a graduate department. The graduate students include 7 per cent, and the professional students 50 per cent, of the students of their respective institutions.

"Ten of the twelve foundations in question report productive funds amounting in the aggregate to $24,567,745, which is 34 per cent of the total productive funds reported for all colleges of liberal arts, schools of science, and professional schools. The total receipts for the year as reported from ten of the institutions were $2,474,463, which sum was made up as follows: income from productive funds, 52 per cent; receipts from tuition fees, 32 per cent; State appropriations, 1 per cent; other sources, 15 per cent."

Another table gives the statistics of twenty-four State universities. "Fourteen of the universities report graduate students, and seventeen report professional students, the number of the former being 2 per cent, and of the latter 35 per cent, of the students of their respective institutions.

"With a single exception, all the State universities report their productive funds, the aggregate amount being $6,881,045. The total income reported for twenty-three of the universities is $1,302,042. This amount was made up as follows: income from productive funds, 32 per cent; receipts from tuition fees, 11 per cent; from State appropriations, 49 per cent; from other sources, 8 per cent. Tuition fees, it will be seen, form but a small proportion of the aggregate income; the details show, further, that in three cases only do they represent a comparatively large part of the individual incomes.

"The attendance upon post-graduate courses in the State universities is small as compared with the same in the twelve universities referred to above. The number of graduate students in the latter is 55 per cent of the entire number of such students reported from all colleges and universities.

"As regards professional schools, theology has no representation in the State universities, and but four schools, with 272 students, in the universities first mentioned.

"The law schools in the table of State universities number 14, with 973 students; and in the twelve universities not supported at public charge, 8, with 1,262 students. The number of medical schools in the State universities is 11, with 969 students; and in the twelve first mentioned, 9, with 2,412 students. The remaining professional students are distributed in dental, pharmaceutical, and veterinary schools.

"The theological students of the twelve universities represent 4 per cent of all such students reported; the attendance upon law schools in both tables, 70 per cent of all law students reported; and the attendance upon the medical schools, 28 per cent of the medical students reported for the country at large."

In this connection, the following facts derived from another source may be interesting to the reader: In 1882–83 the total cost of the Prussian universities was, in round numbers, $1,900,000. Of this sum, 9.3 per cent was their own earnings from tuition fees, etc.: the rest was the contribution of the State, 72 per cent being ordinary and the remainder extraordinary contributions, — for buildings, etc. In the same year the expenditure for gymnasien, including pro-gymnasien, was $3,813,355. The combined expenditure for universities and gymnasien was, in round numbers, $5,700,000.

Attendance upon Colleges and Scientific Schools.

A table is given showing the attendance upon the colleges and scientific schools of the country during the years 1875–76 and 1885–86, and the ratio which such attendance bore to the population at those dates. During the ten years there was a decrease of nine in the number of colleges, and an increase of ten in the number of scientific schools. The attendance upon the colleges at the later date was 7,072 greater than at the earlier period. The percentages of increase were 27 and 28 respectively, while the estimated increase of population during the same ten years was 25.

A comparative view of the relation of students to population by divisions shows an increase in the number of students as compared with population for colleges alone, and for both colleges and scientific schools, in the North Atlantic and North Central divisions of the country, and a decrease in the three remaining sections. It is only fair to remark that in making the computations for the South the colored population is included, and this brings the ratios of students to population down to 1 to 2,489 and 1 to 2,350 respectively in the two divisions of the South. If the blacks are excluded from the computation, the ratios of students in colleges to population in that section become 1 to 1,325 and 1 to 1,548 respectively, and the number in colleges and scientific schools combined 1 to 1,051 and 1 to 1,429.

HEALTH MATTERS.

Baldness.

THE cause of baldness, although long and diligently searched for, yet remains undiscovered. The theories to account for the loss of hair have been many and various. Mr. Eaton, in the *Popular Science Monthly*, attributed it to the wearing of tightly fitting hair coverings, living within doors, and keeping the hair closely cropped. He thinks, also, that this condition is exaggerated by the influence of heredity, and says that there is no reason why bald heads should not yield to the laws of heredity as much as curly or red heads. Mr. Gouinlock, in the same magazine, attributes baldness to the high hat and the hard felt hat, both of which constrict the blood-vessels which nourish the hair-bulbs. Dr. T. Wesley Mills, professor of physiology at McGill University, thinks that both of these views indicate the direction in which the truth lies, but that neither gets at it wholly. The degree to which such peculiarities as baldness are inherited is one of the most disputed matters. Exposure

of the body to sun and air has much to do with hair-production, as Mr. Eaton claims, and as to the truth of which any one may satisfy himself by leaving the arms or other portions of the body uncovered at the seaside or in the country.

Taking up the case against the stiff hat, Mr. Gouinlock explains how readily the arteries can be compressed, especially when the hair is cropped close. He thinks the fact that below the line of pressure the hair remains, while it disappears above it, is quite clear upon his theory; and, to account for the presence of hair over the temporal region when absent on the crown, he insists that here the temporal muscle acts as a cushion, preventing pressure. But this writer seems to forget that there are superficial and middle temporal arterial branches as well as deep ones, and that it is just these superficial ones (liable to pressure) that have most to do with supplying blood to the hair-bulbs. He also takes no account of other methods, besides pressure, by which blood can be cut off from a certain region. The familiar phenomena of blushing and pallor show that the nervous system has a controlling influence over the size of small arteries; and the fact that the hair may become gray in a few hours, under violent emotion, carries with it the lesson that in some way the nutrition of the hair is regulated by this same nervous system.

Dr. Mills says, that, to understand the physiological bearings of this subject, the somewhat complex relations of the blood-vessels of the brain, the face, the bones and muscles of the head, and of the scalp, must be borne in mind. The arteries of the brain find an outlet for their blood, when it has passed through the capillaries and done its work, in those peculiar venous channels lying on the inner tables of the skull known as 'sinuses.' These communicate with the veins of the softer osseous tissue (diploë) lying between the main tables of the cranial bones, which again have connections with the veins on the outside of the head. Now, it is plain, from this series of connections, that pressure on the scalp must influence the whole vascular system of the head back to the arteries of the brain, unless in some way counteracted. Pressure generally affects veins, from their superficial position, much more than arteries. The bad effects of venous dilation are seen in the slow-healing ulcers on the limbs of those with dilated (varicose) veins. Throughout his paper Mr. Gouinlock has directed his attention almost wholly to arteries rather than to veins. He has nowhere mentioned, what is commonly enough seen by the physician, that anastomotic arterial connections are especially opened up under the exigencies of disease, as from the pressure of tumors, etc.

Would Nature refuse to combat the hard hat? Could she not adapt to it in a greater degree than Mr. Gouinlock's theory supposes? In looking at a plate portraying the course of the arteries of the head, it will be noticed that the terminal branches mount to the vertex of the skull, and anastomose with their fellows of the opposite side by *very small* offshoots. As it is the smaller branches of arteries that are the most susceptible to changes in calibre,—can, in fact, be most readily influenced by the nervous mechanism,—it is easy to understand why that part of the scalp, with its hair-bulbs, supplied by them, should, either from pressure or from lessening of calibre in response to nervous influence, be the area most to suffer: hence the explanation of the fact that baldness of the vertex is the most marked. The great increase in the prevalence of all forms of nervous disease, and the modifications wrought in old forms of disease by the greater prominence of the nervous type of human being, point to the fact that our civilization makes calls upon the organization which tell especially on the nervous system. The strain of life falls in general, it will be conceded, most upon men. Man is the bread-winner: his anxieties, struggles, and disappointments are both many and severe; and man is often prematurely bald for the same reason that he is prematurely old in other respects. Woman is less so, because brain stress less frequently falls to her lot. But in connection with this must be taken, to complete the explanation, the fact, that, as with some races and some males of our own race, the vitality and persistence of the hair of the head in woman is specially marked. That overwork of the brain may influence the cephalic circulation (and so the hair) unfavorably, is evident enough from the dark circles beneath the eyes, owing to venous congestion, on the morning after unduly severe mental exercise, not to mention the headache from a similar cause; and it is not surprising that the vertex of the head, with its relatively variable and feeble blood-supply, should suffer most,—in a word, that the overworked or overworried man should be bald,—unless, as in most women, there is unusual vitality of his hair-bulbs. Baldness is one more of the many warnings of our day,—one of Nature's protests against the irregular and excessive activity maintained in this restless age.

PLASTERING WINES.—The Society of Pharmacy of Bordeaux some time ago appointed a committee to examine into the subject of *plâtrage*. This is a process in which plaster-of-Paris is added to wine both to clarify and preserve it. The effect of wine thus treated upon its consumers has long been a matter of doubt, some authorities regarding it as harmless, while others believed that such wine was injurious to health. The conclusions of this committee are as follows: 1. In the present state of viticulture in the south of France and in Algeria, the plastering of wines in the mash is almost always necessary, in order to give the wines the marketable qualities sought after by consumers; 2. Facts are wanting to show that plastered wines are injurious to health; 3. The experience of numerous populations that drink only plastered wine, the experience of the many strangers who are continually travelling through the south of France and Algeria, drinking hardly any thing else than plastered wine, and methodical experiments by learned bodies, show that potassium sulphate in the proportion of sixty grains to the litre of wine produces no appreciable effect on the various functions of the economy; 4. The plastering of wines in the mash to the extent of producing this proportion of potassium sulphate may be authorized until facts rigorously deduced from extensive scientific experiments show the dangers or inconveniences of this amount as regards the public health. The Academy of Medicine, through a committee, has been investigating the same subject, and its conclusions are as follows: 1. The testimony and the facts analyzed in the present report demonstrate that excessive plastering exerts an injurious influence on the public health; 2. From the exclusive point of view of hygiene, the commission cannot approve of the principle of the plastering of wines; 3. Nevertheless in view of the producers' and dealers' necessities, and especially taking the consumers' interest into account, it thinks that it would be imprudent to exclude from the market during certain years, by too absolute a measure, wines which thus far nothing but moderate plastering has proved capable of preserving; 4. Considering that, if potassium sulphate is a natural constituent of pure wines, it never exists in them in a proportion above sixty centigrams to the litre, as analysis shows; that it has not been directly proved that potassium sulphate, even in the proportion of two grams to the litre of wine, has any noxious influence on health, but that it is necessary to fix the maximum of potassium sulphate which may, without appreciable danger, be produced in wine by plastering,—the commission is of the opinion that the presence of potassium sulphate in the wines of commerce, whatever may be its origin, ought not to be tolerated beyond the maximum limit of two grams to the litre. The commission urges that the regulation formerly in force should be carried out strictly.

ORGANIC POISONS.—At the fifth annual meeting of the New York State Medical Association, held at Albany in October, the subject of ptomaines, leucomaines, and extractives, was discussed by several of the members. In speaking of the composition of ptomaines, Prof. Elwyn Waller of New York said that the presence of nitrogen, sulphur, and phosphorus had been determined. They were volatile unstable bodies, some of which could be represented chemically as ammonia in which more or less hydrogen was replaced by the radical CH_3, forming dimethylamine, trimethyldiamine, etc. Their action in the case of the poisonous members of the series when taken into the living body resembled that of the pyridic bases. Some produced a rapid dilatation of the pupil and weakening of the nervous centres, others loss of muscular contractility, others loss of cutaneous sensibility, others a slow action of the heart, others convulsions, others somnolence and torpor, and others pallor with profuse flow of the secretions. He thought that the ptomaines of cholera and typhoid had been found beyond much doubt. All ptomaines, leucomaines, and extractives were converted albumens. Leucomaines were midway between ptomaines and extractives, without definite boundaries between them. They were

divided into groups named uric and creatinic, from resemblances to urea and creatinine respectively. Sixteen were known. All represented progressive changes in albumen. All but one contained oxygen. They had been found in expired air, saliva, blood, brain, urine, pus, and the digestive tract. The progressive changes being interfered with so that retention occurred at some intermediate stage, or by-forms arising as a result of the interference, diseases might at once be produced. The neutralization of these products, even where made by bacteria, must, he thought, be more important than the destruction of the micro-organisms. Dr. N. B. Sizer of Brooklyn stated that canned meats usually owed their poisonousness to the presence of ptomaines, and not to the action of the soldering fluid used. In one instance canned apricots had contained a poison due to some alteration by decay, and resembling tyrotoxicon in its effects. It had killed the child of a nursing mother in a few hours, the mother in forty-three hours, and, after an illness of six days, the father also.

BOOK-REVIEWS.

The Civilisation of Sweden in Heathen Times. By OSCAR MONTELIUS. Tr. by F. H. WOODS. London and New York, Macmillan. 8°. $4.

PROFESSOR MONTELIUS'S excellent summary of the researches on prehistoric man in Sweden is well known to students of archæology, and an English translation of this standard work is highly welcome. The numerous cuts which illustrate the descriptions are of high order, and give particular interest to the handsomely printed book. Mr. Woods had the advantage of the co-operation of the author in translating the work, and thus the translation has become an enlarged edition. All the new matter and new plates that had been added to the German translation of 1885 have been incorporated in the English translation, and the results of recent investigations up to 1888 have been embodied in it. The number of plates has thus been swelled to two hundred and five. The book is pleasantly written, and unrolls a picture of the stone age, the bronze age, and the iron age so far as we are able to reconstruct it from the finds. The description of the last age fills almost two-thirds of the book. Professor Montelius assumes the end of the stone age to be about B.C. 1500. He describes the implements which were in principal use, and the methods of working stone; of chipping flints; and of making perforations by means of a stick and sand and water. A series of excellent cuts shows a great variety of unpolished and polished stone implements, axes, spear-heads, arrow-heads, knives, flint saws, etc. As remains of the earlier stone age are scanty in Sweden, the author dwells more particularly on the latter part of this age, and describes some of the most beautiful implements that have been found. The reader will, however, be particularly interested in the description of the mode of life of the people of this period, in which the author sums up the results of long-continued investigations. He describes the methods of hunting and fishing of this ancient race, their domestic animals, their clothing, and the probable existence of the beginnings of agriculture.

About the year B.C. 1500 the first bronze implements were introduced, and about the same time the first gold ornaments appear. As the forms of burial in the later stone age and the early bronze age are very much alike, Professor Montelius assumes that no immigration took place, but that the new art was introduced by intercourse with neighboring peoples. The bronze age is divided into two sections, characterized by peculiar ornamentations and different modes of burial. We cannot undertake to summarize the author's views, nor his terse description of the culture of each period, illustrated by cuts representing typical specimens and some of the important rock-carvings which are so numerous in Sweden.

The iron age is not absolutely prehistoric, numerous foreign coins being found along with remains of this age. Thus four periods are distinguished, the first reaching to the beginning of the Christian era, the second to the beginning of the fifth century. At this time the later iron age begins, the first part of which extends to the eighth century, while the latter terminates with the introduction of Christianity. In this part of the book the invention of the runes, and their connection with the Roman alphabet, are treated at some length. The accounts of the subdivisions of the iron age are fuller than the preceding chapters, as the finds are far more numerous, and illustrative of aspects of life of which no traces have been preserved in the stone and bronze periods.

Although the book deals only with the progress of the early inhabitants of Sweden, it is not less interesting, as all archæology tends to show that there has been a remarkably similar process of development, not only among European peoples, but among all races of the world. Therefore the author's clear and succinct account of the progress of this people will give the student a clear notion of the successive stages of civilization through which man has passed.

Experimental Mechanics. By Sir ROBERT STAWELL BALL, LL.D. London and New York, Macmillan. 12°. $1.50.

THIS volume is a revised edition of a course of lectures on experimental mechanics delivered some years ago at the Royal College of Science at Dublin to a large evening class consisting chiefly of artisans. The better to adapt his methods to the needs of so practical an audience, the subject has been so treated, that, for its ready comprehension, no knowledge of mathematics is required beyond an acquaintance with the rudiments of algebra and with a few geometrical terms and principles. The elementary laws of mechanics are well and clearly illustrated by simple experiments, the material for many of them being drawn from commonplace sources. Without at any time passing the limits set by the circumstances under which the lectures were delivered, Professor Ball has succeeded in presenting his subject in a lucid and extremely interesting manner.

AMONG THE PUBLISHERS.

D. APPLETON & Co. announce for this week 'The Florida of To-Day,' by James Wood Davidson, intended for settlers and tourists, giving the geography, climate, history, routes of travel, the geology, productions, sports, etc., describing the population, education, employments, etc., and including full list of hotels, and railway and county maps printed in colors. This is an entirely new work on this popular winter resort. 'Appletons' Handbook of American Winter Resorts,' revised for 1888 to 1889, will also be ready, with illustrations, railway time-tables and fares, maps, etc., brought down to latest date. A most useful guide for invalids and tourists.

— Robert Clarke & Co. of Cincinnati have in press, and will shortly issue, an octavo of 250 pages with the following title: 'Know Thyself: A Study of Man,' by a well-known Cincinnati physician, Dr. J. D. Buck. The book contains an outline of general biology and physiology, upon which the higher problems are based, and from which the true science of psychology must proceed.

— J. B. Lippincott Co. have in press a 'Life of Henry M. Stanley,' by H. W. Little; a 'History of the celebration of the One Hundredth Anniversary of the Promulgation of the Constitution of the United States,' edited by Hampton L. Carson; and 'A Shocking Example, and Other Sketches,' by Frances Courtney Baylor.

— *The Cosmopolitan* magazine has been purchased by John Brisben Walker, who will be remembered as the founder of the *Inter-Ocean.* Mr. Walker is establishing new headquarters at 363 5th Avenue, New York.

— J. W. Bouton, New York, will publish early next year a work on 'Remarkable Bindings in the British Museum,' for which Mr. H. B. Wheatley has prepared the text, and which is to contain sixty photogravure plates. "This is evidently intended," says the *Nation,* "to do for the British collection what M. Bouchot's sumptuous work did for the French; and, in recognition of the fact that the French interest in the art of bookbinding is greater than the English, there will be a simultaneous edition published in French by MM. Gruel and Englemann. The edition is limited to two hundred copies in English and two hundred in French.

— *The Princeton College Bulletin* is the title of a new quarterly publication to be issued from Princeton College. It will be philosophical, scientific, and literary in character, with President Patton as general editor, assisted in the various departments by several others.

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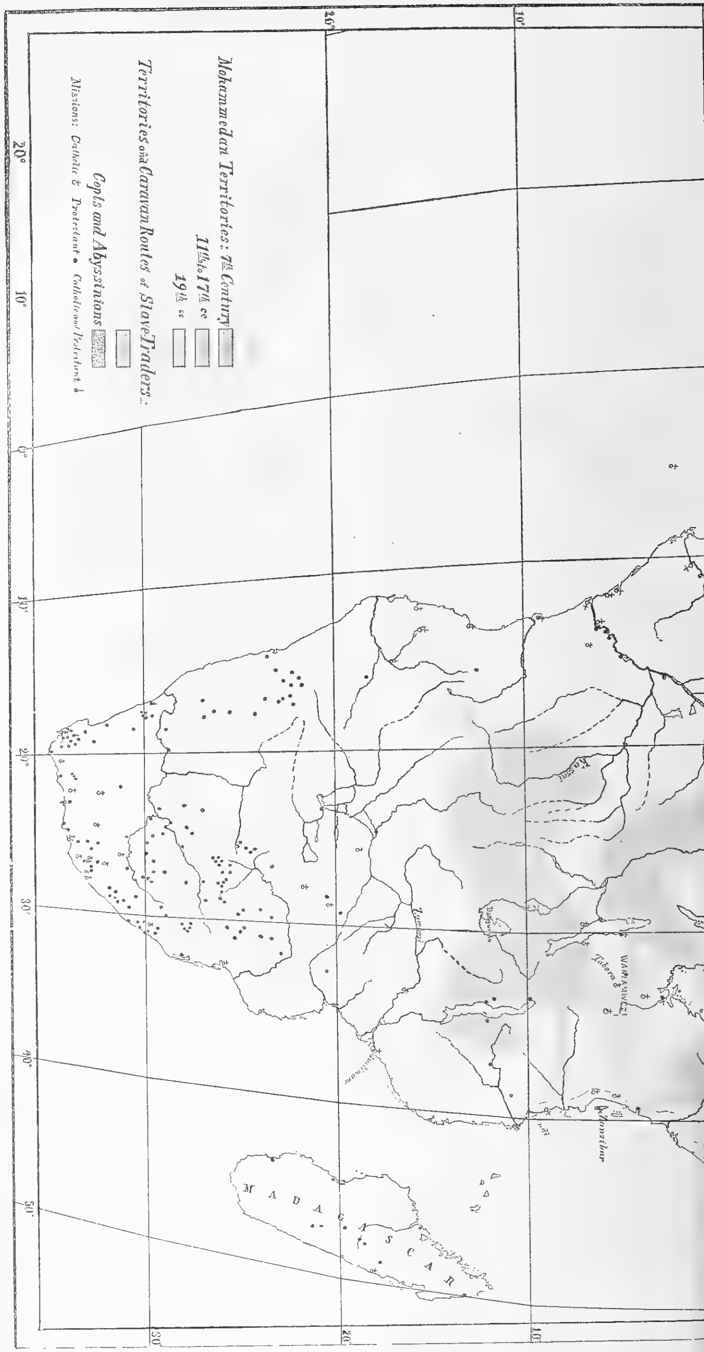
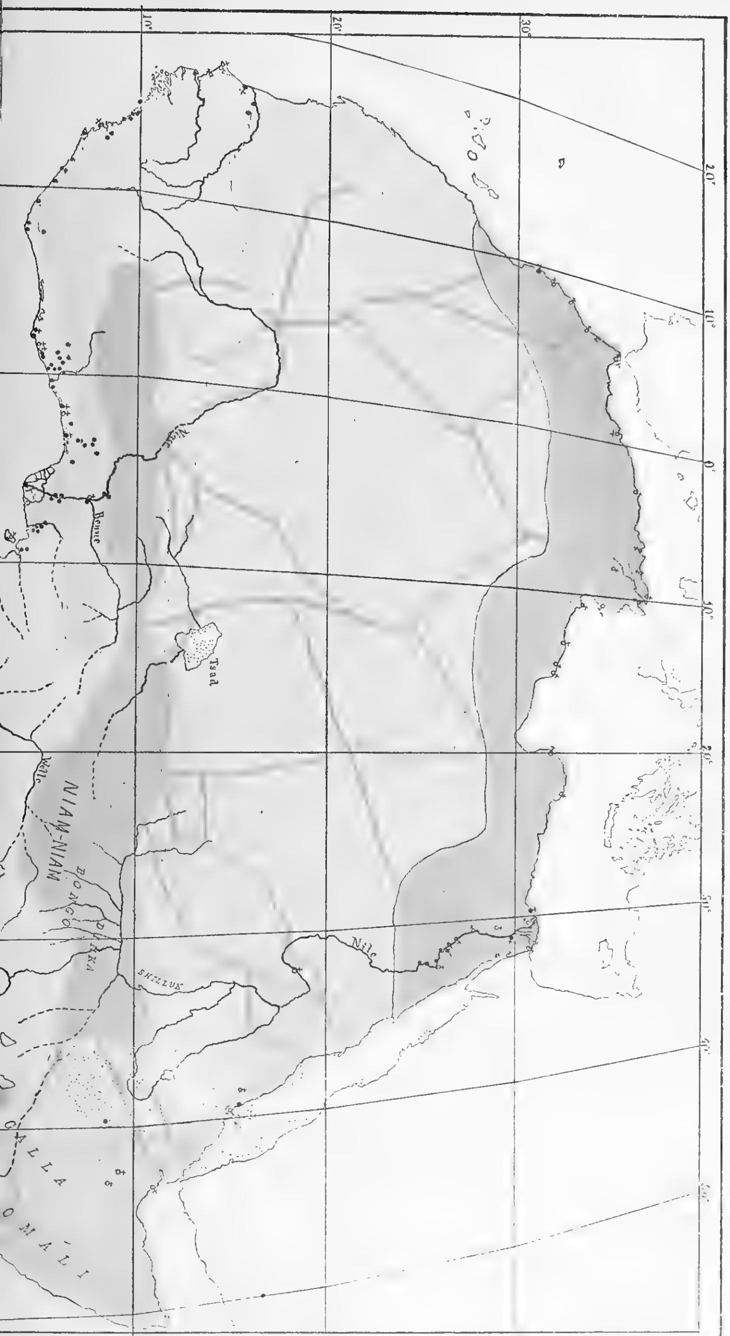


MAP OF AFRICA,
Showing the Spread of Mohammedanism and the Extent of Slave-Trade.

SCIENCE, December 28, 1888. No. 308



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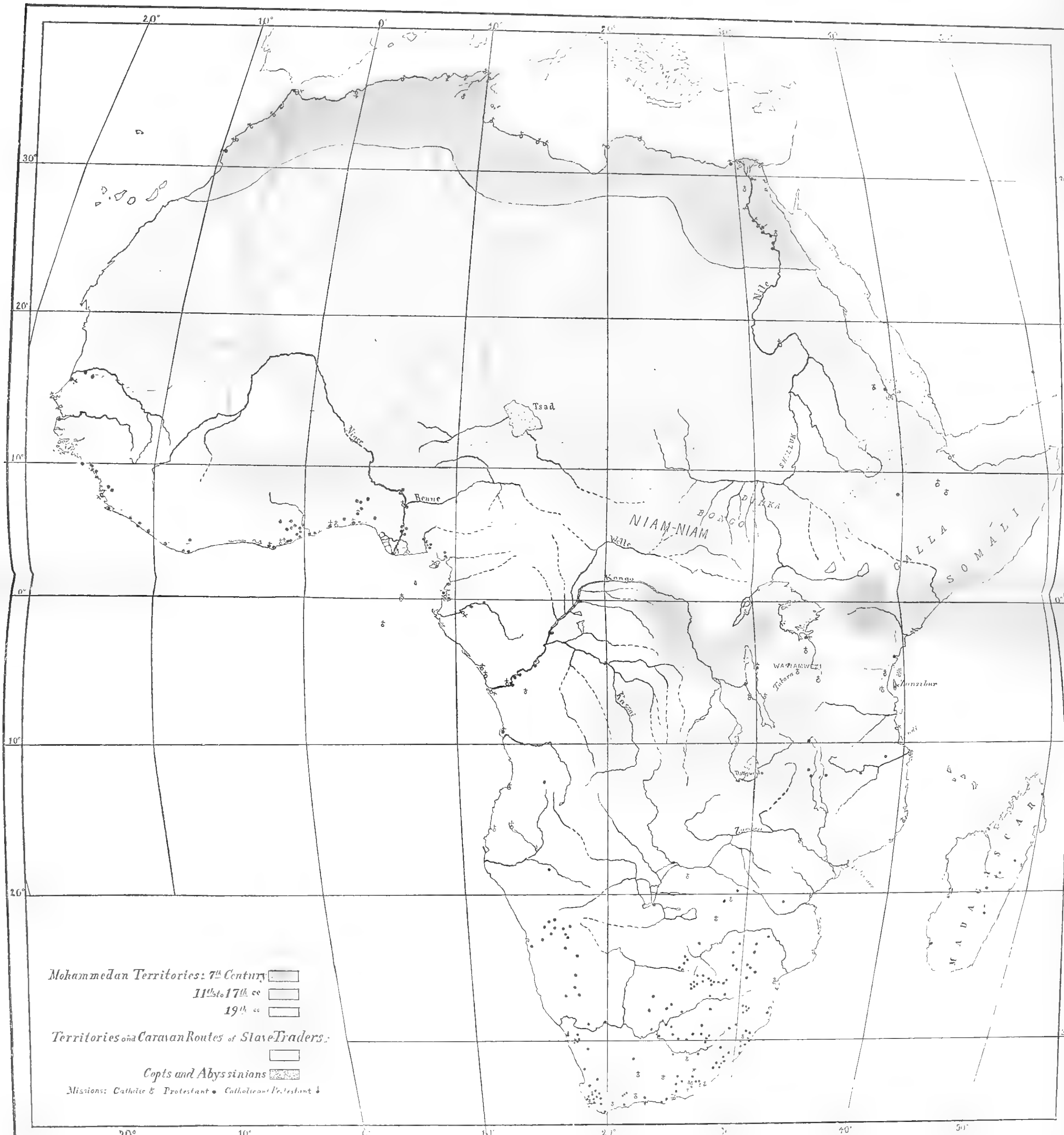

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ANDREWS, E. A., and STODDARD, S. A Grammar of the Latin Language for the Use of Schools and Colleges. Revised by Henry Preble. Boston and New York, Houghton, Mifflin, & Co. 453 p. 12°.
BALL, R. S. Experimental Mechanics. 2d ed. London and New York, Macmillan. 359 p. 12°. $1.50.
BRYCE, J. The American Commonwealth. Vols. I. and II. London and New York, Macmillan. 1493 p. 12°. $6.
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